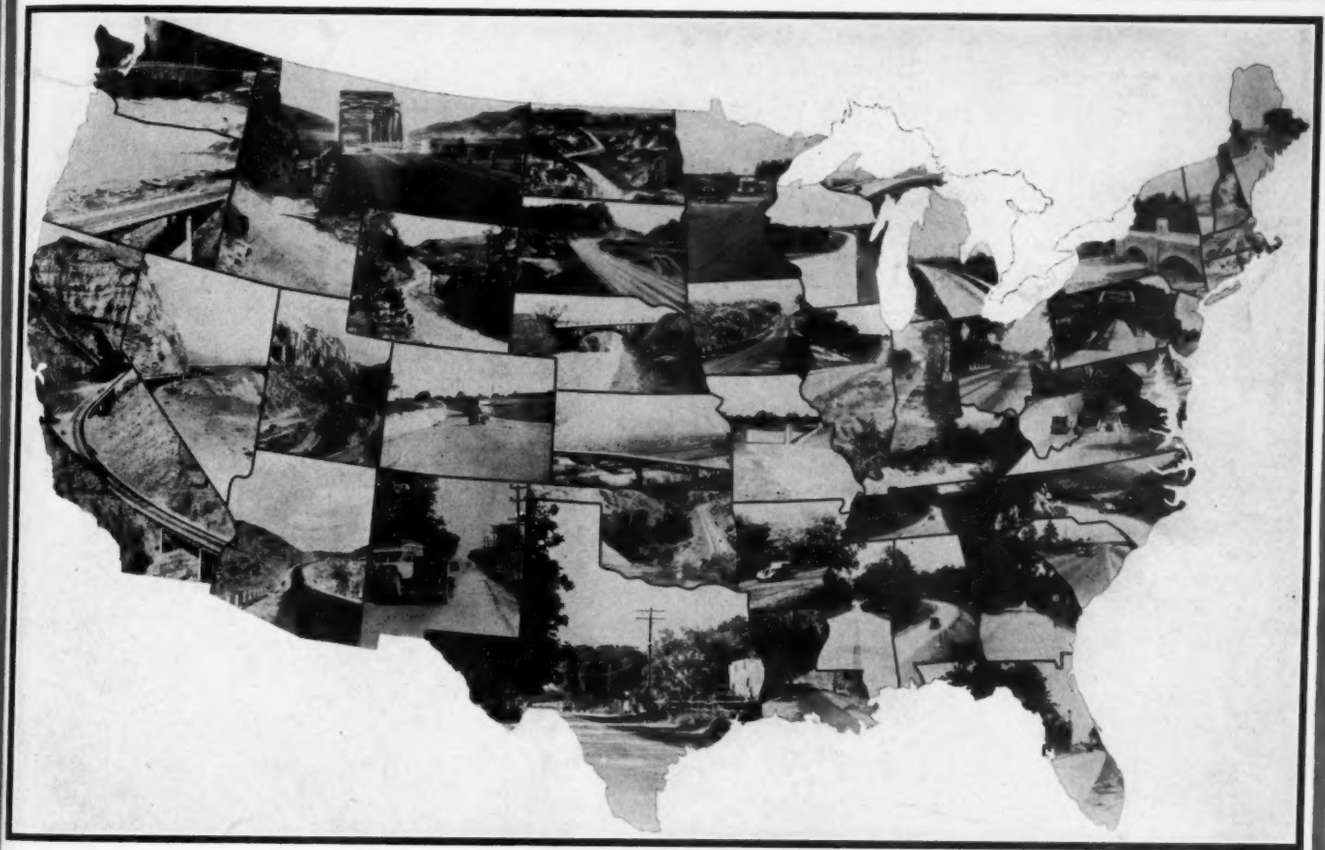
PUBLIC WORKS

City, County and State



The Bureau of Public Roads prepared this "road map" of the United States for exhibit at the Road Show, using typical views from each state to make up the whole.

• • • IN THIS ISSUE • • •

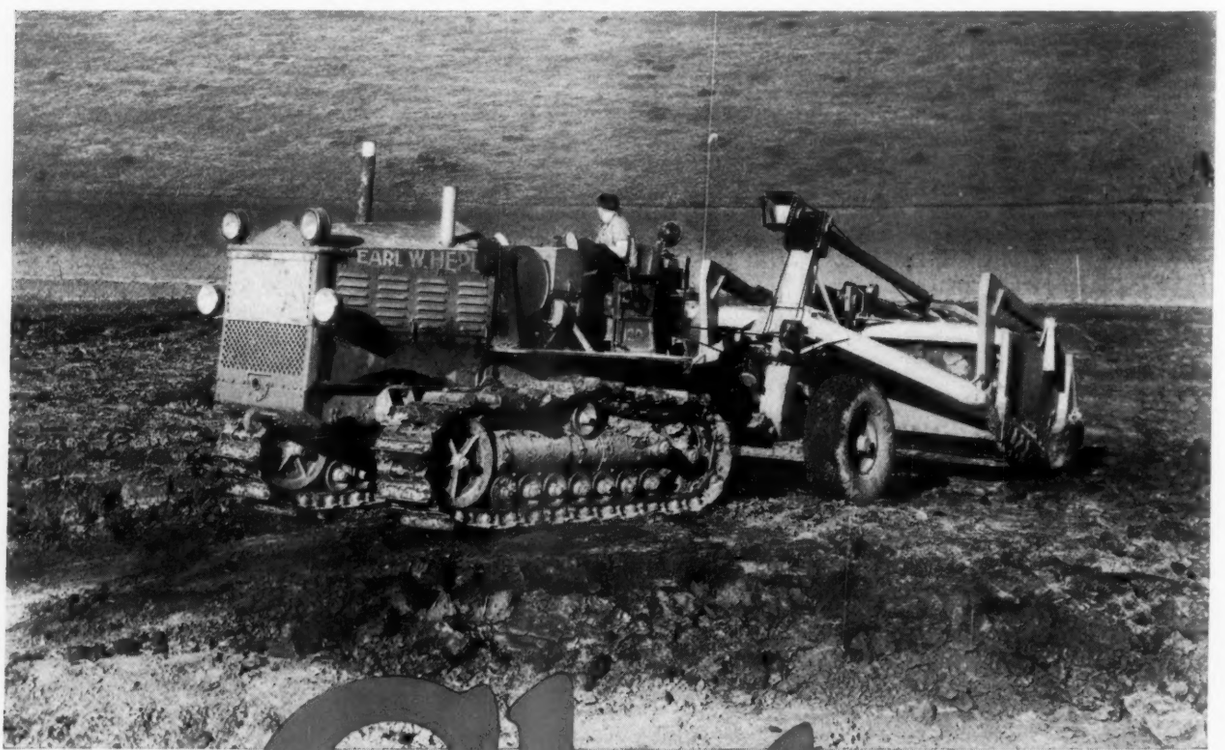
FEBRUARY, 1936

Yardage . . .

After a year's operation, "The best tractor I ever saw"
—SAYS WEST COAST CONTRACTOR.

• Since purchasing his Cletrac 80 Diesel in December, 1934, this contractor has worked it continuously. Average fuel consumption has been four gallons per hour and on many jobs, working with a 12-yard self-loading scraper, the tractor has hauled its load in high gear. • The owner states that the Cletrac 80 Diesel is the best tractor he ever saw and that it has plenty of power, performing exceptionally well—particularly on hills. • Balanced weight at the tractor guarantees maximum usable power at the drawbar, larger pay loads and increased yardage results. • Use Cletracs and benefit by increased yardage for which you get paid.

The Cleveland Tractor Co. • Cleveland, Ohio



. . . Cletrac

VOL. 67 PUBLIC WORKS No. 2

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FEBRUARY, 1936

PUBLIC WORKS

City, County and State Engineering and Construction

FEBRUARY, 1936

Contents

Timewasters

Water, Water, Everywhere:

There are three houses in a certain suburb where the water pressure is poor. In front of these three houses are three dead ends. The layout is thus:

These are the houses

O O O

o o o

These are the dead ends

The problem is to connect all three houses to all three dead ends, without having any of the lines cross or join. *By MCH.*

Another Waterworks Problem:

This is the old one about the frog down in the well. The well is 30 feet deep. The frog jumps up 3 feet at each jump and slips back 2 feet. How many jumps does it take him to get out of the well.

And Still Another:

If from a jar containing three pints of water, one pint is transferred to a jar containing 3 pints of alcohol, the contents thoroughly mixed, and one pint of the mixture returned to the first jar, is there more alcohol in the one jar than there is water in the other jar? *By John Bevan.*

Turning Backward:

How about last month? How many were successful in working out the murder problem? Well, they had one-fourth of a chance to get the man from room 1313, and one-twentieth of a chance of getting him from room 711. Therefore, the chance that the "moiderer" is caught is 3 out of 10.

We neglected to make Russell Chatfield cough up the solution of the sines for the seven angles, but we'll get him later. As for the steel girder which some misguided gentlemen (probably some WPA workers) are pushing through the corridor, well they're out of luck unless that corridor is 6.65 feet wide, and they might as well go back and start over again.

Extra Measure:

We're saving space on solutions, so we'll add another problem, which was sent us by E. R. Dike from down in Tennessee. A room is 20 feet long, 10 feet wide and 10 feet high. A spider is one foot from the ceiling in the center of one end, and a fly one foot from the floor in the center of the other end. What is the shortest distance the spider can crawl to reach the fly?

Extra, Extra!

The business department of PW has assembled some 35 prize Timewasters in a neat little booklet, tucking the answers off in the rear. They say it costs 10 cents to make up, and they will be glad to send it postpaid to you for a dime in cash money or in Mr. Farley's stamps. Send your contributions, if any, to Book Dept., at the address shown southwest of this column, and you'll get it promptly.

SUBSCRIPTION RATES: United States and Possessions, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

A. PRESCOTT FOLWELL, Editor — **W. A. HARDENBERGH,** Asso. Editor

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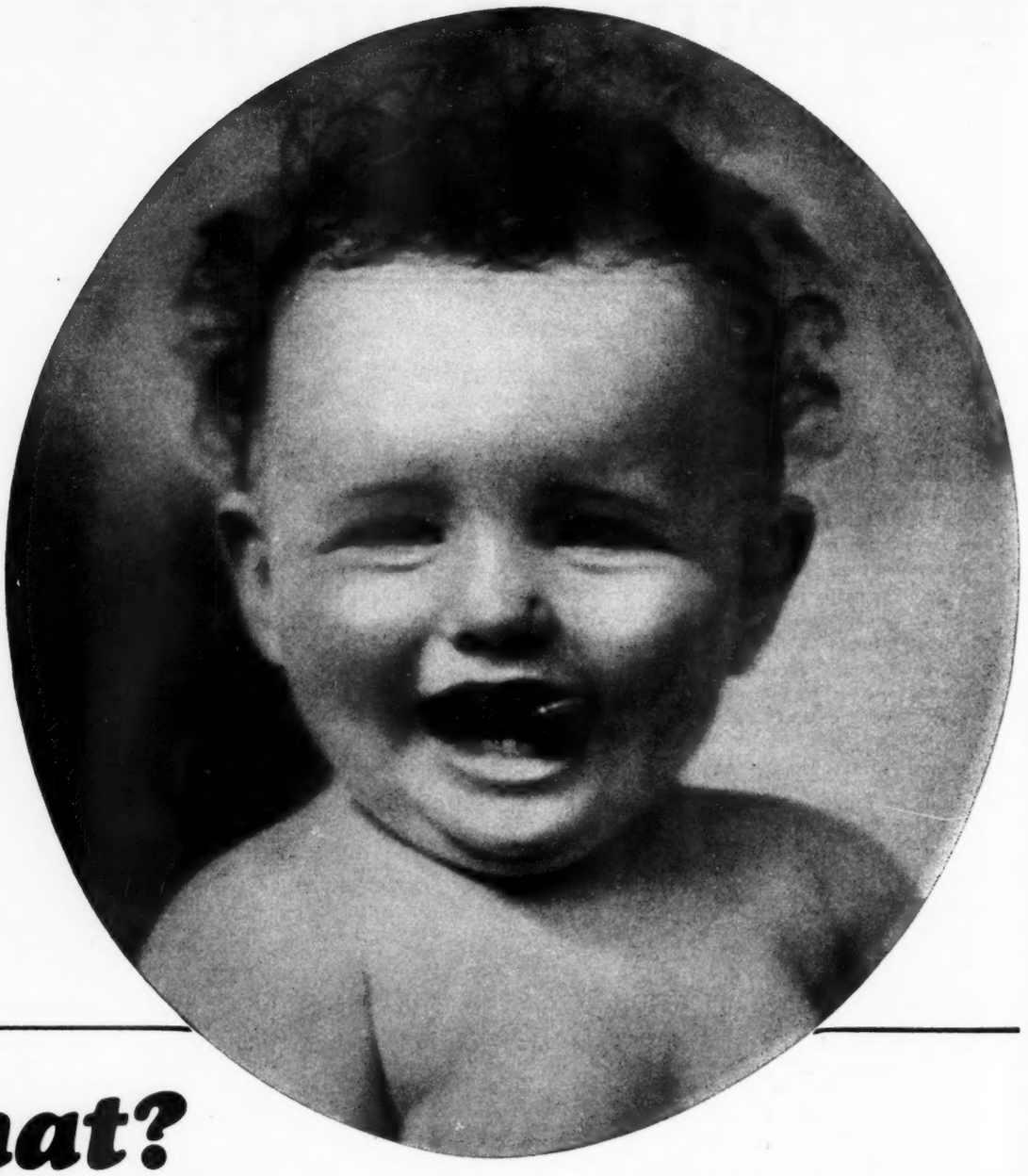
FOUNDED IN 1896



What?

. . . A Little Girl in a Road Tar Ad?

Exactly! . . . There is more reason to put a picture of a little girl into an ad about road tar than almost anything else you could put into a road-materials ad.

Because one thing which makes road tar different from many other road materials is the fact that tar makes it safer for little girls to ride on roads . . . and to walk along streets.

How important is that? Well, 40,000 of the people killed and injured in automobile accidents in 1934, were under four years of age.

How sure are we that wider use of road tar would cut accidents? Positive! Highway and city officials have put light surface treatments of Tarmac and chips on notoriously slippery roads and cut the accident rate. There is nothing theoretical about this.

So, that's why we put a picture of a little girl in a Tarmac ad. It may help keep more little girls alive and well.

And yet skid-resistance is only one of the many reasons you should use road tar for better results in your 1936 paving work. Penetration, binding power, easy workability, weather resistance . . . all make tar the best bituminous material. Write to Koppers Products Co. 1208 Koppers Building, Pittsburgh, for new construction specifications.

KOPPERS **Tarmac** MAKES SAFE ROADS

KOPPERS PRODUCTS COMPANY, PITTSBURGH, PA.

Representatives in Principal Cities

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 51-53

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 67 — *February, 1936* — No. 2

Novel Control Valve for Elevated Water Tank

By O. J. Semmes, Jr.

City Engineer, Pensacola, Fla.

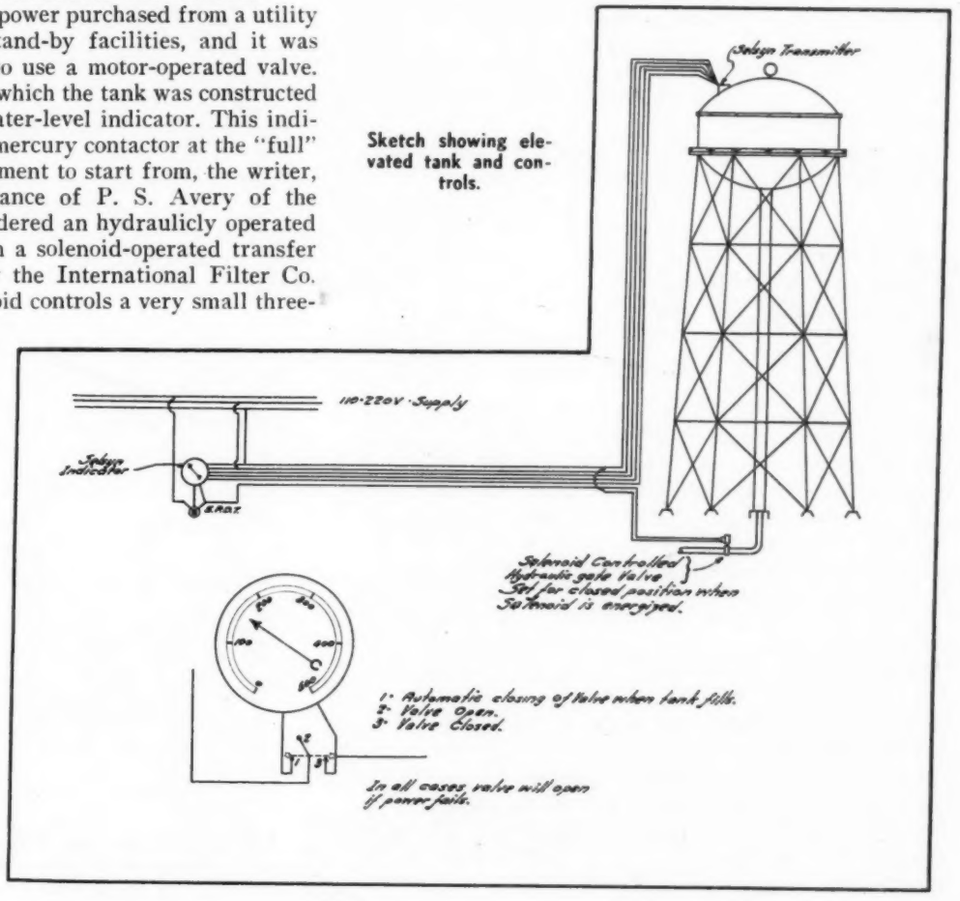
A PART of the recent water works improvements installed by the City of Pensacola, Fla., was the construction of a 500,000-gallon elevated tank. The work was done under authority of PWA Docket 1812. No automatic valve was contemplated in the plans for the project, it being believed that by providing an accurate water level indicator at the water pumping station, successful operation could be had without a control valve at the tank. However, it was soon apparent that if an emergency demanded a boost in pressure it would be necessary to send an operator a half-mile to the tank to close the gate valve in the supply line. With this in view, and with a desire to retain operator control of the valve as well as automatic features, the writer designed and installed a control system which he believes to be ideal for the conditions encountered.

Pensacola pumps with power purchased from a utility which has inadequate stand-by facilities, and it was therefore impracticable to use a motor-operated valve. The specifications under which the tank was constructed provided for a Selsyn water-level indicator. This indicator is equipped with a mercury contactor at the "full" position. With this equipment to start from, the writer, with the valuable assistance of P. S. Avery of the Rensselaer Valve Co., ordered an hydraulicly operated gate valve equipped with a solenoid-operated transfer switch, manufactured by the International Filter Co. The position of the solenoid controls a very small three-way valve. Direction of flow through the three-way valve actuates piston-operated poppet valves which in turn control the direction of flow to the hydraulic cylinder of the 16" gate valve. The ports are designed to close or open the valve in one and one-half minutes. The hydraulic valve is equipped with outside screw and yoke above the cylinder and a removable hand wheel. The transfer switch is adjusted so that the main valve will be open when the solenoid is de-energized.

With this arrangement, the valve on the supply line to the tank will close automatically when the tank fills. It will open automatically in case of a power failure. It can be opened or closed by the operator at the pumping station by means of a single-pole double-throw switch.

The cost of the installation was considerably less than any of the fully automatic altitude valves. It has all of the ruggedness, dependability and low pressure loss characteristic of a gate valve. It is automatic to as great extent as seems desirable.

Docket 1812 was supervised by the writer as city engineer. William B. Lamb was resident engineer inspector, PWA, for the first part of the job and upon promotion was succeeded by Arthur H. Brown.



Sketch showing elevated tank and controls.

Methods Used in Preparing Maps of the Virginia Secondary Highway System

By A. H. Bell
Asst. Engr. Surveys and Plans, Virginia Dept. of Highways

THE general assembly of Virginia, session of 1932, approved an act to relieve the counties of Virginia of the maintenance and improvement (including construction and reconstruction) of certain roads, streets, bridges, landings, and wharves; to establish the secondary system of state highways; and vested the control, management and jurisdiction over the secondary system of State highways, thereby created, in the department of highways of the commonwealth of Virginia.

Under the provisions of this act the state highway department was directed to make provision for preparing maps of the several counties of the state showing thereon the roads of the secondary system of State highways in such counties upon which funds would be expended.

Preliminary Maps for Recording Field Data

The maps used in the earlier road inspections and field mappings were, naturally, of a preliminary nature due to the lack of any complete map of many of the counties. However, the State department of highways had available the Virginia map sheets of the U. S. Geological Survey, a few complete maps prepared by some of the county authorities, and old maps of the counties used in establishing the state primary highway system. These available maps were of various degrees of completeness. Several sections of the state had not been completely surveyed and mapped by the U. S. Engineers. Many of the old county maps had inaccurate indication of such necessary items as existing county boundary lines, waterways, roads.

In preparing the preliminary maps for use in the field logging and inspections, prior to assuming control of the county roads, the work was standardized in the setting up of procedure by showing on one map sheet as much map information as possible on the one particular county and including on supplement sheets any additional information not clearly indicated on the main map sheet. This embraced such items as accurate indication of road conditions in congested city or town subdivision areas.

Outline map tracings of each of the several counties were prepared, using as much of the available information as possible. Available maps were enlarged or reduced by the pantograph method and by photostating, and one scale was adopted for all map drawings to indicate the representative fraction. On these outline map tracings was indicated in ink only definitely known information such as boundary lines, waterways, rivers, and streams; and included, in pencil, any information which would aid the field logging parties, such as general location of roads, towns and geographical features. This information was penciled on the tracings on account of the doubt of correctness and, although required for field logging, any erroneous data could be easily taken off the tracings without damage to the cloth. These tracings were blue line printed and a print forwarded to the Resident Highway Engineers, who were charged with the field logging of roads in each of the counties.

Field Logging and Data Secured for Maps

In order to secure logs and mapping data promptly and as accurately as possible, without running out survey traverses, each resident engineer was instructed to log by automobile each of the county roads to be taken over by the state department of highways and to be included in the secondary highway system. Each resident engineer was authorized to have a man drive his car, a man to record notes, and to employ the county supervisor or district foreman to accompany him and indicate the roads actually considered as public roads which had been under the supervision of the county authorities.

Transit note books were used as descriptive log books for recording the field data secured. The right pages of these books were used, as in taking topography, having plotted along the center line notations of road intersections with distances between intersections, streams showing direction of flow, location of churches and schools, and house count, or location of houses, except in villages. The left page was used for descriptive information of the roadway, indicating mileage, type, condition; descriptive information of bridges and other similar structures, showing length, width, type and pres-

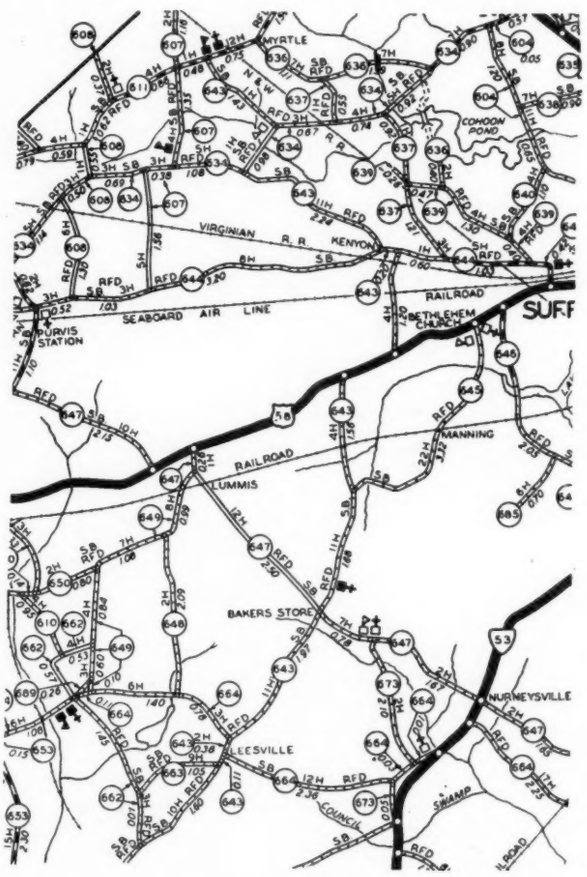


Fig. 1. A portion of the map of Nansemond Co., Va. An amazing amount of information is given. For instance, from Baker's store to the junction **(see next page).**

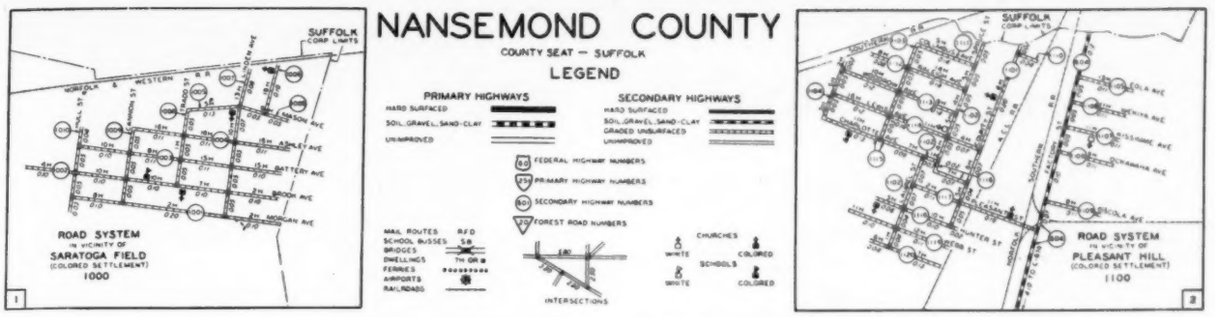


Fig. 2. The small drawings at the left and right are details of areas south of the city of Suffolk, see below, numbered 1 and 2. The center shows the legend employed. A scale of miles is also shown on the map.

ent condition. Notations were also made in the descriptive logs of each road to show the local names of roads to indicate mail routes, school bus routes and railroad crossings.

The average mileage per day by these automobile field parties was around 60 miles.

Secondary route numbers were originally assigned in the field by the resident engineers, using the same system in each county. This permitted classification of roads by route numbers and in a definite system according to traffic. The most important county roads—those leading through the county or connecting towns or villages or State primary routes—were numbered and classified in one group or number series. The second most important roads, those that carried considerable local traffic, but not of a through nature, were numbered and classified in a second group or number series. Strictly local roads such as loops, dead end roads, etc. carrying very little traffic were classified and numbered in a third group or number series.

All of the map information secured during the field logging of the roads was transferred to the preliminary or log map by the resident engineers in each of the several counties. One standard system of conventional signs was established whereby accurate indication could be made on these maps of such data as route numbers, road types, railroads, mail and bus routes, bridges, ferries, airports, schools, churches, and mileages between intersecting roads. This preliminary or log map, together with the descriptive log books were forwarded to the highway department main office at Richmond, where the final county map tracings were prepared.

Final Drawing and Revision of Maps

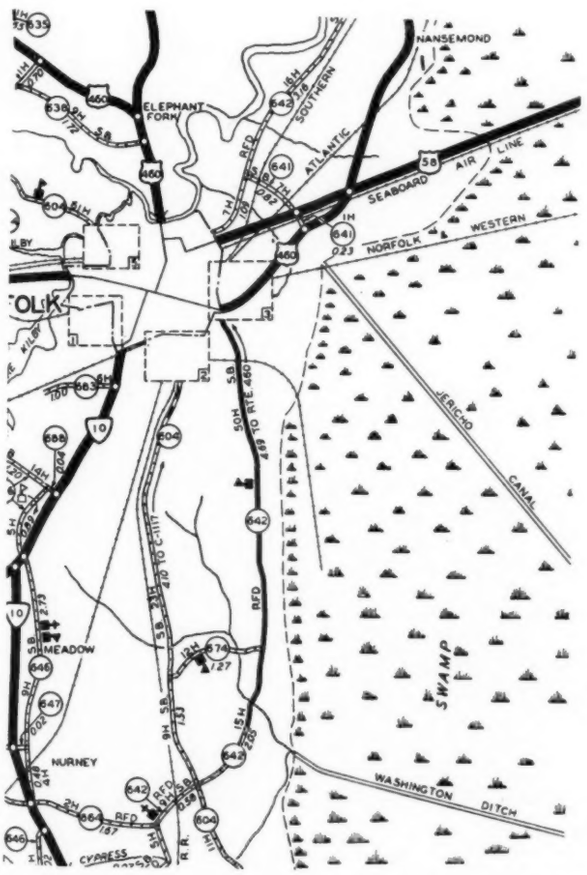
Each map tracing was of sufficient size to show the outline of one particular county with boundary lines and names of adjacent counties or states. This main county map tracing had indicated thereon a title with legend and tabulation of secondary road mileage in the county. Any road conditions of congested areas around cities or towns which could not be clearly shown on the main map sheet were shown on supplement sheets at an enlarged scale. The final map tracings included all the map data secured during logging of the roads. The same system of conventional signs appeared on these tracings as was used on the log maps. U. S. highway routes and state primary highway routes were marked with the proper route numbers and the type of each was also shown. Guide templates were made for drawing the conventional signs for route markers, churches and schools. Uniformity of lettering the map tracings was accomplished by the use of mechanical lettering guides.

After a year's operation of the secondary highway system in Virginia it was found advisable to set up a better system of numbering routes. To avoid conflicting records and to eliminate unnecessary duplication of road numbers all secondary roads were renumbered beginning with Route number 600. A secondary road passing through two or more counties was assigned one number. Secondary roads in each city or town subdivison areas were numbered in a separate series beginning with Route number 1000.

The maps of the secondary highway system in Virginia are continually being revised. Relocation and construction of state primary routes as well as the increasing number of new roads result in frequent additions and abandonments to the secondary system.

Besides the usual auditing, construction and maintenance records, the department keeps a map record of mileage changes in the secondary system, whereby the total mileage maintained on each route and the total mileage in each county is known at all times.

Once each year a general revision of maps is made.



North of Leesville is Route 643; it is an RFD and a School Bus road; the length is 1.97 miles; and there are 11 houses located on it.

Vermont Flood Control Projects

THE most disastrous flood in Vermont's history occurred in 1927. Much of the flood damage was caused by the Winooski river which, in the Montpelier area, cost 55 lives and $13,500,000 property damage. Since 1933, works to prevent the repetition of such floods have been under construction, utilizing the Civilian Conservation Corps. It was at one of these camps that the fire of last Christmas occurred.

Three dams are under construction, all of the rolled earth fill type. Two of these were begun in 1933—Wrightsville and East Barre—and a third and larger one—Waterbury—was put under construction more recently.

The Wrightsville dam, started in 1933 and now practically complete, is 90 feet high, 1600 feet long

General view of East Barre dam with granite riprap face.

and contains 1,115,000 cubic yards of fill material. Considerable equipment has been used in construction, including McCormich-Deering equipment. Several T-20 Trac Tractors were used in the preliminary stages of the work, in stripping and in excavating for the cut-off trench. The photographs herewith showing the

Sign near East Barre dam, describing its purpose.

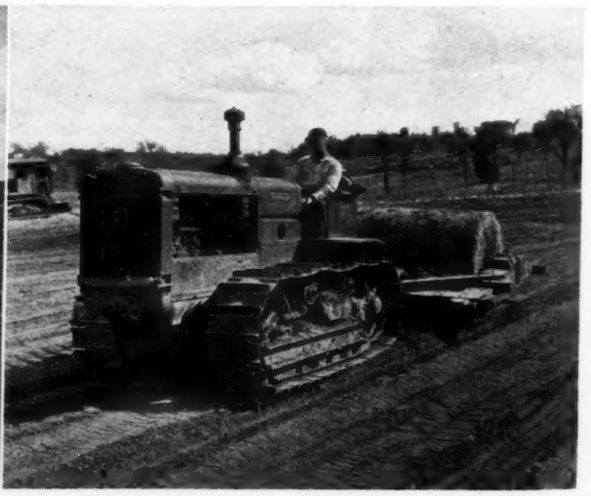
work at the three dams were furnished us by the International Harvester Co.

The East Barre dam, details regarding it and its history, are described quite fully in the accompanying illustration of a sign-board erected at the site of the work. This, too, is a rock fill dam, compaction generally being obtained by running crawler tractors back and forth over the fill, though a concrete roller, as shown in one of the illustrations, was also used.

Winter work on these two projects was limited largely to rock excavation and to quarrying and hauling granite blocks for the rip-rap for the face of the dam. Despite the low winter temperatures—it reached 15° below zero in December, 1935—no particular trouble was encountered in starting or using the equipment.

The Waterbury dam will be the largest of the three, also a rolled-fill earth dam. This will be built across the Little River, another of the tributaries of the Winooski. The work on this dam was begun last season with a fleet of 42 International trucks, some of which are shown in the illustration herewith.

International motor trucks at work on Waterbury project



TA 40 "Trac Tractor" pulling 8-ton concrete roller on East Barre earth-fill dam.

Operating Small Sewage Treatment Plants in Southern States

By Charles Carroll Brown
Consulting Municipal Engineer, Gainesville, Fla.

VISITS to existing plants, north and south, and several years of experimentation on an Imhoff tank in Florida have led the writer to certain conclusions, some of which are in accord with results in other plants while some have led to the development of operating methods which have not been observed elsewhere and have not been found in the literature on the subject.

Florida plants enjoy certain advantages which make easy a continuous satisfactory operation of sedimentation and digestion tanks, both double-duty tanks and those in which the two duties are performed in tanks more or less separate. (The septic tank, Imhoff tank, and separate digestion system are the popular methods of sewage treatment in Florida.) These advantages are as follows:

a. The temperature of sewage is not low enough in winter to reduce the temperature of the sludge and the lower depths of the settling sewage below about 80 deg., F.—the approximate optimum temperature of sewage or sewage-sludge digestion.

b. The amount of sewage in any one plant is small. No plant now in existence in Florida is too large for the program of daily operation suggested, except when overloaded by storm drainage.

c. The smaller plants can be operated ordinarily without sampling and analyzing the sewage, unless in exceptional circumstances or to overcome the consequences of gross neglect or misapplication of the program. Only two or three require tests and measurements as a basis for occasional special treatment.

d. As a consequence of the conditions stated in (a), the digestion of sludge is practically constant. The winter storage of sludge, so troublesome in the northern plants, is no problem in Florida; therefore plants designed according to northern standards have extra space in the digestion chamber, so that the drawing of sludge can be handled to the best advantage of the product. This results in ripe sludge, completely digested.

e. If the plant has a capacity somewhat in excess of the maximum rate of discharge of sewage, the operation will be more satisfactory than if it is too large or if it is overloaded. Either extreme will make the plant difficult to operate.

Natural sand beds for draining sludge are generally available by simply grading, the top soil being used for banks around the beds. When sludge is drawn after the proper period for digestion (cessation of draft being determined by a slight odor, increasing liquidity of outflow, or depth to which the tank has been drawn down), the almost constant warm sunshine dries the sludge in a very short time and puts it into condition for shoveling into cars or sacks to be used as fertilizer for grass—a real necessity in Florida. This air-dried sludge does not have the strong odor of artificial fertilizers when applied, or that of prepared activated sludge when moistened by rain or sprinkling.

The slogan of the program is "Keep the plant clean." Odors arise from decomposing matter on the surface of walls and on screens, and on the ground around the plant. Keep all these surfaces clean. Water under city water works pressure is an absolute necessity. The size of pipe, hose, and nozzle depends on the water pressure, size of the sewage treatment plant, the hours spent in cleaning up, and items in the program below. Hard water has some advantages in keeping the pH indications near neutral.

The Operating Program

1. Rake off the bar screen, breaking up any fecal matter so that it can pass through the screen with the sewage. Keep back wood, paper and cloth, to be removed with the screenings.

Rem. This reduces the load on the digestion process and adds but little to the refuse to haul off.

2. Draw the sand out of the grit chamber, letting floating matter (except the intercepted wood, rags, and paper) flow on with the sewage.

Rem. A hoe with handle shaped to permit the blade to follow closely around the curved bottom will draw the heavy matter up onto the pavement along the grit chamber. Small slots in the upper part of the blade will let water back into the chamber without washing all the grit back with it. Sand from defective sewers is often a serious obstacle to cleaning digestion chambers.

3. Load the debris into a wheelbarrow to be hauled off at once and buried. If held over to get a barrow load before burying, odors will be given off.

Rem. Trenches with a covering of two or three inches of sand are recommended. Parallel trenches covering the refuse in one trench with the excavation from the next will require little effort and perhaps a quarter acre will be sufficient to decompose the organic matter before the trenching comes around again to the same area.

4. Wash off the screen and walls above and below the platform of the grit chamber, forcing the washings into the flow of sewage.

Rem. Decomposing matter about this part of the plant is often neglected and becomes a prominent source of odors, especially if such matter is allowed to scatter over the surrounding ground and rot there.

5. Use a stream of water from hose in breaking up the scum on the surface of the sewage in all the sections of the tank formed by the baffle boards and partition walls. Work backwards from the outlet. Should there be much scum in the section at the outlet weir, dip or shovel it into the gas chamber so that it will not run over into the outlet ditch or pipe.

Rem. The stream from the hose should be from a sprinkler-head, a nozzle, or the open hose, according to the requirements as to force and amount of water. The disturbance of water in the tank by the water treatment should go below the surface only far enough to produce the desired results. The digesting sludge should not be disturbed.

6. Use hose and rake, squeegee, or hoe as much as may be necessary to break up the scum in the gas-chambers until it is soft and mushy, thoroughly soaked with water so that it will let gas through as rapidly as it comes up.

Rem. The operator should try to liberate from the scum the gas brought up by it from below; concentration of odorous gases should be prevented. If the scum remains too long on the surface, it will dry out, a tarry substance being produced under some conditions of digestion, and will concentrate the gases and their odors. Walls, especially of gas-chambers, will be much defiled by scum and all surfaces of walls must be washed thoroughly every day. Mosquitoes and flies breed in scum and standing water and are a major reason for daily treatment. Every smallest chamber or

water surface, even the vertical branch of the sludge removal pipe, must be treated. Scum-making material coming to the surface again shortly after treatment has not had all gas driven out of it by the treatment but may usually be left for further treatment until the next day.

In a small tank, foaming can usually be prevented by thorough operation of the program. A few buckets of lime water well loaded with extra lime hydrate will help when used during the hosing of the gas chambers. Larger plants require expert attention. It is quite desirable that the lower story of the Imhoff tank be disturbed as little as possible. Go no deeper with water under pressure than necessary to break up the scum—seldom more than two or three feet. Hard water of the usual Florida supply aids in keeping pH at the proper figure.

Economy results from daily treatment. One to four hours' daily work of an intelligent negro costs less than concentrated work for days of several hands under expert direction to remove the results of bad action. Small flow of regular sewage, as in a college tank in vacation time, may not require continuous operation of the program, but this will not be true for a small municipal plant, even though the load is much below its capacity.

Sludge can remain in a small plant for several months, but rise of partly digested sludge through the slots at the bottom of the flow-through channels will indicate that the digestion compartment is too full of sludge and that it should be drawn. Do not be too liberal with the draft. Smaller quantities drawn several days apart will keep the tank in better balance than infrequent drawing of large amounts.

Cold Process Asphalt Road Construction

The author claims that a dense non-skid surfacing, unlikely to develop corrugations because it contains the minimum of both binder and filler, is more easily produced by the cold process than by the hot, as the surfacing produced by the former method retains its plasticity during construction and also throughout the necessary final compaction under traffic. Further, damage to the binder through overheating is eliminated, satisfactory junctions between work done at different periods are easily effected, and the decreased importance of the time factor allows a central plant to serve a number of construction sites. It is also possible to place durable but relatively thin surfacings (0.4 to 0.8 in.) by the cold process, the minimum thickness for the hot process being estimated by the author at 1.2 in. The correct amount of binder is easily determined by inspection, and the work can be carried out by unskilled workmen under the direction of a foreman. Road Abstracts: J. OBERBACH: *Bitumen,* 1935, 4 (7), 137-43.

Utilization and Treatment of Industrial Wastes

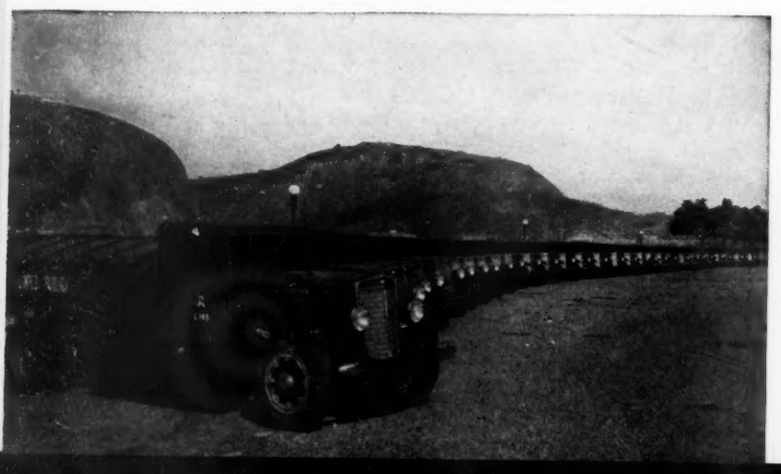
In its report for the third quarter of 1935, the Wisconsin Bureau of Sanitary Engineering, L. F. Warrick, state sanitary engineer, reports that construction work is rapidly progressing in the installation of a full-scale demonstration plant employing the Howard process for the utilization of sulphite pulp mill wastes. This installation is being made at a Wisconsin sulphite mill with a capacity for producing 100 tons of pulp per day, which should permit a definite demonstration of the practicability of the process both as regards waste utilization and stream improvement. Preliminary tests indicated that the pollutional loadings on an oxygen demand basis can be reduced at least 75 per cent by the process.

Based upon research conducted by the Bureau during 1934, a full scale treatment plant for malt wastes has just been completed and put in operation at Jefferson Junction. This plant employs fine screening, biological filtration and secondary settling facilities, provision being made to return a portion of the trickling filter effluent to the influent. It is expected that tests to determine whether high treatment efficiencies obtained with the experimental plant are being secured with the new installation will be carried out in the near future.

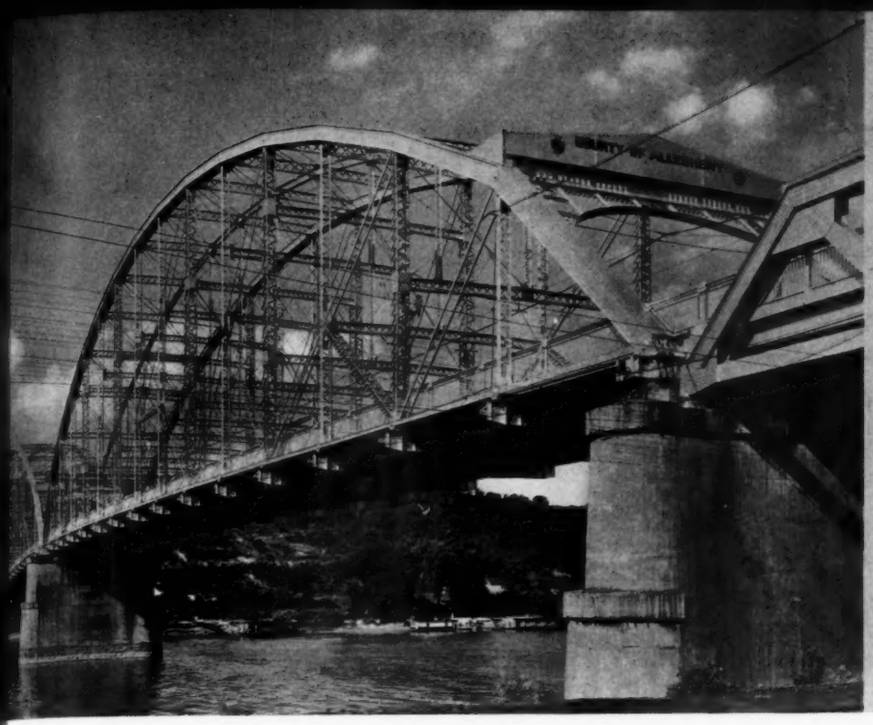
Studies conducted several years ago on the digestion of solids removed from tannery wastes when mixed with sewage sludge, are being followed up on a full-scale basis at Fond du Lac, Wisconsin. Provision was made during the quarter to pump the tannery solids from the two clarifier units installed last year to the two sludge digestion tanks of the municipal sewage treatment works. While some foaming occurred during the first two weeks of operation, this has now ceased and apparently digestion is proceeding satisfactorily. Tests are contemplated to verify or disprove the results of the previous studies, which indicated that within limits the tannery sludge could be successfully digested along with the municipal sewage solids.

A complete milk waste treatment system of latest design was placed in operation at a condensery at Waupun during July, 1935. The installation includes a waste flow-equalizing tank and pump sump, trickling filter with rotary distributor and time clock dosage control device, and a secondary settling tank. Very effective treatment for milk wastes other than whey is accomplished by these systems.

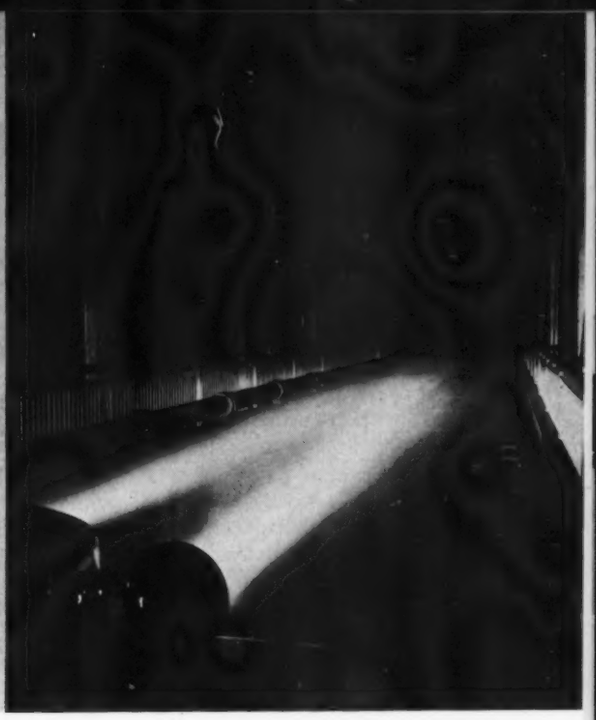
Below: Thirty International Model C-50 trucks with special steel garbage bodies and hydraulic hoists in use by the City of Rio de Janeiro, Brazil. The city fleet now numbers approximately 350 Internationals.



Below: The City of Nictheroy, capital of the state of Rio, Brazil, has a fleet of nine Model C-30 International truck units with garbage bodies and manually operated hoists which was recently placed in service.



Aluminum-painted bridge across the Ohio river at Coraopolis.



Illumination of aluminum paint on a foggy night.

Painting Bridges With Aluminum Paint

BECAUSE of its good protective qualities and high visibility, aluminum paint has been widely specified for finish coats on steel bridges. Satisfactory results with aluminum paint, as with any other paint coating, are more certain when care is taken to secure the best quality of pigment and vehicle, and when attention is given to the proper method of preparing and priming the steel surface and to the correction of common faults in the application of the finish coats.

Aluminum paint differs from other structural paints in a number of ways. Its pigment is flake-like in shape, and its color and good appearance depend on the ability of a portion of these flat particles to arrange themselves on the surface of the film in the form of a relatively complete sheet of metal. This property is known as "leafing." The remainder of the particles distribute themselves in more or less parallel layers, uniformly throughout the film. It is this unusual arrangement that contributes to the sunlight resistance of the coating and to its moisture impermeability. Dried aluminum paint films average somewhat thinner than those of other paints but, because of the plate-like structure of the pigment and its layer-form of distribution in the vehicle, the effective film thickness is greatly increased; i. e., water vapor and other gases must follow much longer paths through the resistant varnish to reach the underlying surface.

Aluminum pigments are available in either paste or dry powder form. They vary by grades in fineness and thickness of the individual particles. In general, greater durability is obtained with an aluminum pigment that possesses good leafing power and has the greatest possible number of flakes per unit weight. Most good aluminum pastes give better performance because the flakes are not only approximately one-third the thickness of the flakes in the standard grades of powder but are much smaller in mesh size. This is one of the chief reasons for the present widespread use of aluminum paste in place of powder in making good aluminum paints.

No matter how good the pigment, the quality of the finished paint depends in large measure on the kind of vehicle selected as the carrier. Brittle resin varnishes, low in oil content, may produce aluminum paints that have as satisfactory an appearance as those made with durable resins combined with a substantial quantity of heat-treated linseed and china-wood oil, but their ultimate life is short. Specifications for aluminum paint vehicles should be drawn as rigidly as possible to secure only those varnishes that possess high resistance to moisture passage and the best elasticity. The slightly higher cost of such vehicles is more than offset by the increased service they render.

To protect metal for long, paint coatings, even those possessing chemically inhibitive pigments, must be applied over dry, clean surfaces. The corrosion products of steel are not only pure iron oxide but gelatinous precipitates on the metal, which entrap large quantities of water. This water contains dissolved acids and salts. Such rust carries within itself all the necessary elements for further destruction. It must be removed or made inactive before any paint is applied, or its action will continue beneath the film. Not only should loose surface rust be wire brushed, but deep pits should be cleaned to the bottom with chip hammers or sand blast. Loose mill scale, unless removed, will likewise lead to early paint failure. Rust in inaccessible places may be made less detrimental if heated with a blow torch for a sufficient time to drive out retained moisture. Application of the priming coat should follow the cleaning operation as soon as practicable, and before new rust starts on the unprotected surfaces.

Paint pigments for metal are often divided into three classes—rust-exciting, rust-inhibiting, and chemically inert. Aluminum falls into the third class, a fact that generally limits its use on bridges to finish coats. While

Photomicrograph of a cross section of an aluminum paint film on foil, illustrating how the metal flakes orient themselves.

aluminum paint gives excellent service on new rust-free steel without special primers, this ideal cleanliness is difficult to obtain on bridge members. Better results are secured if the first coat is a paint containing rust-inhibitive pigments. These pigments, such as zinc chromate, red lead or basic lead chromate, are slightly soluble in water. They tend to dissolve in the adsorbed moisture held by the rust remaining on the steel and, by chemical action, greatly reducing its corrosive activity. However, rust inhibitive primers cannot be accepted as a substitute for thorough cleaning, but are principally intended to take care of such small amounts of rust as may have been overlooked. A good priming paint, carefully applied over a well cleaned surface, is a foundation that seldom has to be replaced if inspection and maintenance of the top coats occur at sufficiently frequent intervals.

Aluminum painted bridges possess excellent night visibility. When illuminated by the head lights of an automobile, the members reflect light back to the driver with attention-attracting brilliance. It is therefore essential that the alumium paint finish coats be applied in such a manner as to develop maximum reflectivity and good leafing.

The common practice is to use two coats of aluminum over a primer, since it has been found that such a procedure produces better durability and better appearance than where other types of intermediate coats are specified. In order to distinguish between two succeeding coats of aluminum paint, the first should be tinted with Prussian Blue paste or some other acceptable tinting pigment. Two ounces of Prussian Blue paste to a gallon of aluminum paint made with powder is usually sufficient, but because of the high pigment value of aluminum paste it is sometimes necessary to add four or even six ounces of blue pigment to get a good contrast. There is no evidence that this addition materially affects the durability in any way, although it may slightly retard drying.

Aluminum paint is applied by either brush or spray machine, the latter being the preferable method from the standpoint of freedom from brush marks and laps. Unfortunately, in most cases spraying is impractical and bridges must be painted by brushing. However, job-mixed aluminum paint in the hands of careful workmen produces satisfactory results, comparable in every respect with the spray application.

In applying the final coat, the aluminum paint should be "flowed" on and then brushed out, making sure that all final strokes of the brush are in the same direction. One of the chief faults of most conscientious painters is their tendency to "over brush." After the paint has been applied and properly brushed out, it should be left without further attempt to smooth out remaining minor irregularities. As the leafing proceeds, the flowing property of the varnish vehicle eventually gives a smooth, uniform appearance. However, once the paint begins to "set," because of loss of thinner, its viscosity increases rapidly. The leafing film, once formed and then disturbed by an unnecessary stroke of the brush, never reforms completely, leaving a dark, unsightly streak in the finish.

This difficulty is most frequently encountered when the surface is hot, such as occurs on a warm summer day. Sometimes it is necessary to add a small quantity of raw linseed oil (not more than 5 per cent) to the vehicle to slow down the initial set of the paint in order that complete leafing may occur and to avoid too marked a contrast on the laps. A better way is to secure a varnish vehicle that has a slower initial setting to touch time, say four or five hours, instead of the usual two hours.

No finish coat of aluminum paint should be applied when the temperature of the steel is below forty degrees. Varnish vehicles at this temperature become quite heavy and may cause the aluminum flakes to leaf so slowly that the paint dries before the pigment can develop a completely leafed surface. This results in a poor looking paint job, although it is doubtful if the durability is much affected unless the temperature is below freezing.

The appearance and reflectivity of the final coat may be affected by the use of aluminum paints that have darkened from standing mixed for too long a time. If the brightest possible finish is desired, it is well to mix the paint as needed and only enough at one time for that day's use. Small amounts remaining may be mixed in with new paint the next day without detracting noticeably from the color.

Because freshly mixed aluminum paints possess the unique property of leafing, this type of coating is frequently recommended for painting wood bridges and guard-rail posts made of treated lumber. After the wood has been allowed to weather for six or eight months, aluminum paint will show little or no discoloration from the bleeding of the oil-soluble creosote. Such coloring matter as is absorbed in the varnish is hidden completely by the surface sheet of aluminum metal. The silver white color is maintained with a reflectivity adequate for all safety considerations. Two coats of aluminum paint are recommended, applied directly to the wood without a special primer. The varnish vehicle should be of the hard drying china-wood oil type and should show exceptionally good leafing qualities if it is to be in all respects satisfactory.

The Use of Paper Under Concrete Road Surfacings

Excessive friction between slab and subgrade may be avoided by laying down strong paper before the concrete is placed. The paper must be strong enough not to tear during placing. Such strength must be retained if the paper is wetted. The wetted paper must not be liable to form folds or to bunch up and thereby cause weakening of the slab. A rough judgment of papers can be made by the bursting pressure test, in which samples are loaded by air pressure over a circular area of 100 cm.^{2} (15½ sq. in.). The test is made on the paper after storage in air at a temperature of 15° to 25° C. (60° to 80° F.) and humidity of 65 per cent, and also on samples which have been kept for 2 hrs. under water. Minimum bursting strengths of 0.5 kg./cm.^{2} (7 lb./sq. in.) for the air-dry condition and 0.2 kg.cm.^{2} (2.8 lb./sq. in.) for soaked paper are recommended. Impermeability to water is not necessary and, on grounds of economy, should not be specified.—O. Graf: *Betonstrasse*, 1935, 10 (7), 131-3. From Highway Abstracts.

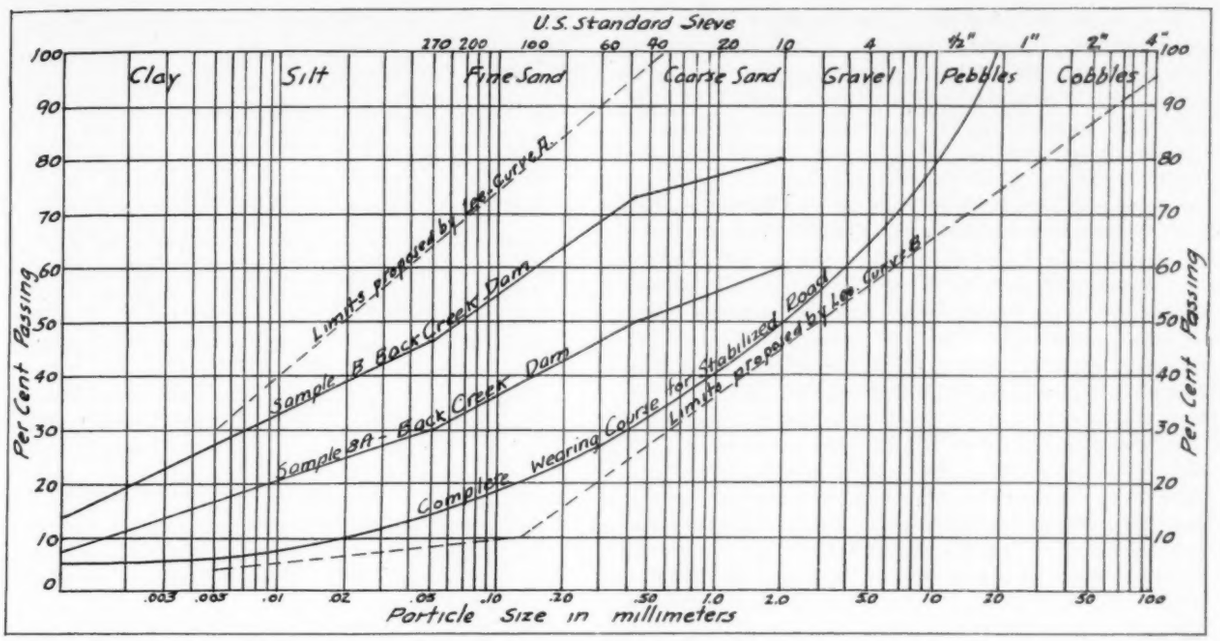


Fig. 10. Semi-logarithmic chart showing curves A and B, which indicate limits proposed by Lee for ungraded materials. It is believed this chart is sufficiently accurate to be traced and analyses plotted on it. Curve of analyses should lie between A and B and be generally parallel to them. Other curves shown here represent suggested or actual analyses of materials used.

Materials for the Construction of Earth Dams

By W. A. Hardenbergh

Third in a series of articles referring especially to the design and construction of small earth dams.

THE study of soils has, in recent years, produced a wealth of knowledge of value in earth dam construction. The fact that these studies have been made largely by highway engineers and for the purpose of building better roads merely emphasizes the relationships existing between the various branches of engineering. The purposes of these studies have been: (1) To enable the construction of earth bases strong enough to carry traffic loads with only a thin wearing surface of bitumen, and (2) to develop an earth wearing surface which would be so dense and impervious that it would carry light traffic without rutting or becoming dusty or muddy.

By graded mixtures of soil materials, using calcium chloride or other diliquescent salt to maintain a proper moisture content, a surface has been developed which is so dense and firm as to ring when struck with a hammer; and it also resists any cutting or scraping from the blade of a road grader.

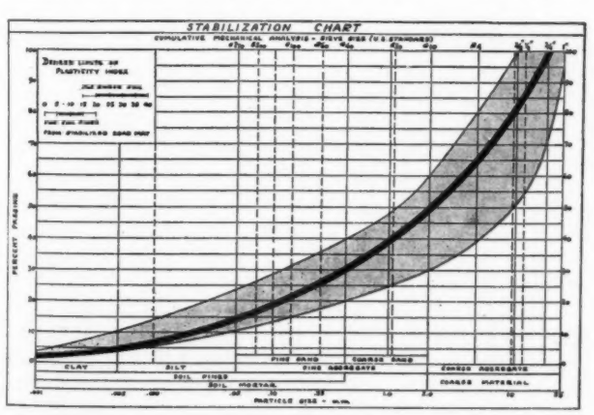


Fig. 8. Stabilization chart for complete highway wearing course.

Presumably a dam constructed of such materials would be nearly impervious to leakage, very stable and highly resistant to erosion from heavy rainfalls, wave action, and even to some extent from overtopping.

However, proper grading of selected materials is not sufficient alone to produce such results. The moisture content affects very materially the ability of the soil mixture to remain stable under all conditions and is, in reality, a determining element.

In considering this, it must be remembered that, in stable soil, each particle is coated with a film of moisture. If this film is too thick, it acts as a lubricant and the soil tends to flow under pressure; or, if enough moisture is present, from its own weight. A thick mud will flow or give when stepped on. On the other hand, if the moisture film is too thin or absent, its place is taken by air. In this case, as with dust, compaction is impossible and cohesion between the particles is lacking.

When a moisture film of the proper thickness is present around each soil particle, the particles are held tightly together through increased surface tension. Terzaghi states that moisture films less than two-millionths of an inch thick behave like semi-solid substances.

It might appear difficult to control the moisture in an earth dam against which water stands at all times. However, when a soil is compacted to maximum density with the moisture content at the optimum mentioned above, its affinity for moisture is satisfied and it will take up no more.

Use, in general, the principles necessary in making good concrete, proportioning clay, sand and gravel so that voids are filled. The theoretical amount of clay is not generally enough, and in practice around 15% to 20% will be needed. Fig. 8, which shows the particle size gradation for a stabilized road, has 15% of the material passing the 270-mesh, and about 25% passing the 60-mesh. Fig. 9, from a paper by Charles H. Lee before the American Society of Civil Engineers, shows reasonable limits for ungraded materials and Fig. 9a for graded materials for impervious sections of rolled-fill earth dams. For suitable materials, curves should lie between the limits shown, generally parallel to them, and of a shape reasonably corresponding to them. The curve of Fig. 8 may be plotted on Fig. 9, as a check, remembering that the ½-inch opening corresponds to 12.6 m.m., the 10-mesh to about the 2.0 m.m., the 40-mesh to 0.5 m.m., etc. Similar plottings for check purposes may be made of the samples shown in Table 1, page 17, PUBLIC WORKS, June, 1935. Fig. 10 shows several curves, and also the stabilized road analysis.

The characteristics of the soil under consideration, so far as grading is concerned, can be determined by sieving and plotting on a chart similar to Fig. 9 or Fig. 10. In addition to the proper gradation of particle size, soil must be insoluble. It should, of course, be available at a reasonable cost. Other factors commonly included in considering the suitability of soils include stability, watertightness within reason, and workability. Properly graded and compacted soils meet these requirements.

When soil is not available of the desired character, sieve tests will show in what way it is deficient—whether in fine material or in coarse. It may be economically possible to make up this deficiency by adding clay or sand, as needed, during construction.

Moisture Content

A soil suitable and properly graded being available, the next problem is to determine its optimum moisture content for compaction.

In making the compaction test, which was devised by R. R. Proctor, about 5 pounds of dry soil passing the No. 4 sieve is thoroughly mixed with just enough water to make it slightly damp, compacted in a cylinder, the sample weighed, the bearing value determined by the needle and the moisture content determined by drying in an oven. This procedure is repeated, each time increasing the amount of water enough to raise the moisture content about 1%, until the soil becomes wet and there is a decrease in the wet weight of the unit volume of compacted soil. Fig. 11, which was sent us by C. A. Hogentogler, Jr., shows the two curves resulting from this test. It will be noted that for this soil a moisture content of about 19% is required for maximum compaction; while for this condition, the bearing value of the soil is about 1100 pounds per square inch.

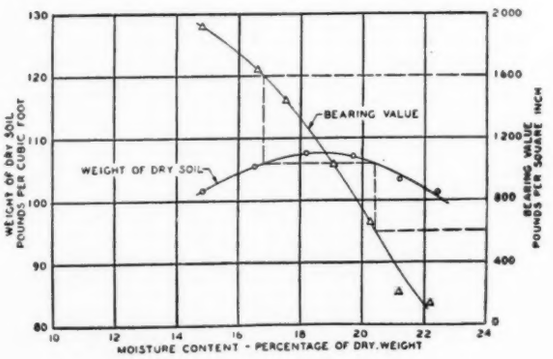


Fig. 11. Curves obtained from compaction data.

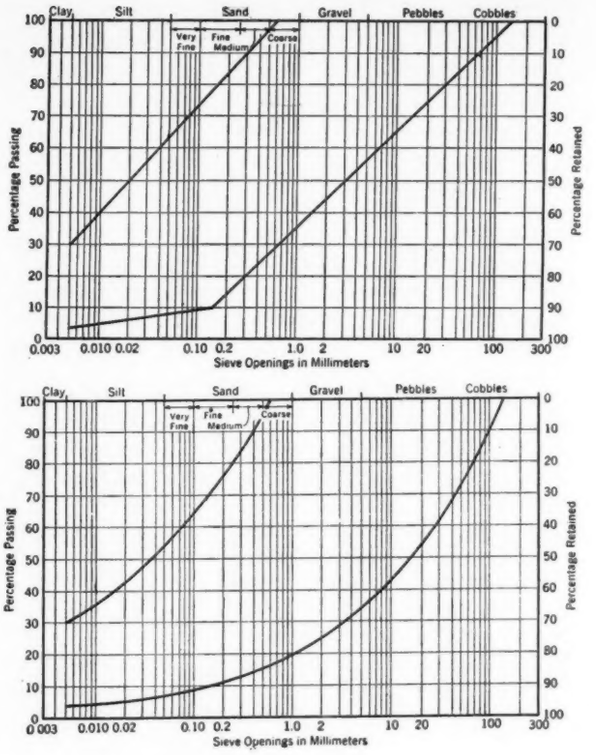


Fig. 9 and 9a. Lee's curves.

It will be noted also that with the moisture content at about 19% the weight per cubic foot of dry soil is at a maximum of about 108 pounds. The bearing value of 1100 pounds at the 19% moisture content is greatly exceeded by the bearing value at about 17% moisture. But the weight per cubic foot of dry soil is less, the moisture content is not stable, since, as shown by the dotted line on Fig. 11, additional moisture may be taken up, even beyond 20%; and at a moisture content of somewhat over 20%, the bearing value is only 500 pounds.

This optimum moisture content should be determined for the soil or soils selected for the dam, and maintained during construction by sprinkling the fill or by spreading the dirt in thinner layers and allowing it to dry before rolling.

Control Equipment

The testing and controlling equipment is neither complicated nor costly. Nor is it difficult to operate. A letter from C. A. Hogentogler, Jr., who has done much work along this line, states:

"The equipment necessary to perform the tests for control during construction is as follows:

Compaction cylinder and rammer; Plasticity needle; Cenco triple beam balance; Soil augur and three extentions; No. 4 sieve; Spatula, 3½" blade; 1 dozen, 6 cm. diam. evaporation dishes; Gasoline camp stove and oven; Spring balance, 30 lb. capacity.

"The cost of this equipment is about $105. The additional equipment needed to perform all tests for the selection of the material, costing about $37 additional, is:

Attachment to compaction cylinder; No. 40 sieve and pan; Two 12 cm. diam. evaporation dishes; 400 c.c. beaker; 25 c.c. graduate; 25 c.c. burette.

The Editor's Page

Automatic Control in Water Works Plants

For many purposes a man is not so reliable as a machine, and there are an infinite number of services which a machine can perform much more perfectly than a human being. It therefore would seem advisable to employ a machine to perform these functions; and if none is available, to devise one. Thus we will get better results and generally at less cost.

For example, the engineer at a water works pumping plant cannot sit continuously in front of a gauge to so regulate the pumping rate as to maintain a constant level in elevated tank or reservoir; but there are several devices which will automatically perform such regulation, maintaining the elevation within almost any desired range of accuracy.

In softening river water, any one of several occurrences may cause a sudden increase in hardness which should be met at once by increased doses of chemicals. A superintendent cannot keep a chemist testing the water at even ten-minute intervals night and day; but a device has been used which gives instantaneous warning of any change in the hardness of the water entering the plant, and may even be made to vary the chemical dose automatically to correspond.

In this month's "Water Wheel" reference is made to pressure-reducing valves, relief valves, altitude valves and other forms of mechanical control. Pittsburgh's Saline station is provided with remote control of several stations, whereby water elevations in reservoirs and pressures in distribution systems are maintained automatically within narrow limits, this control having paid for itself in less than a year by reduction of operating personnel.

Elaborate systems for remote and automatic control may not be justified in the case of many small plants, but the use of such devices is applicable and justifiable in many more cases than is generally realized by the small-plant superintendents. A device employed successfully by a medium-sized plant is described in the leading article in this issue.

It would be worth while for superintendents of even the smallest plants to familiarize themselves with the various types of equipment available for remote control, if not for automatic; and we predict that many of them will be surprised at learning of the number of ways in which they can improve the efficiency of plant operation and the low cost thereof.

Importance of Public Works Officials

Of two hundred officials in charge of municipal public works in cities of over 10,000 population who furnished information to the secretariat of the A. M. E. and I. A. P. W. O., 100 have had four years of college, 71 no college training and 29 less than four years. At the time of appointment 98 of them had been holding positions as engineers, 70 in public service, and 22 in charge of sewers, streets or other public services.

But a number of cities had put in charge of their public works bank presidents, commissioners of finance, the city auditor, the city marshal, the secretary to the mayor, councilmen, merchants, insurance men, salesmen and other non-technical citizens.

Of the 200, 4 had held their positions for 25 years or more, 43 from 10 to 25 years, but 108 had been appointed less than five years previous.

By far the largest capital investment of most cities of more than 10,000 population is in its public works—streets, sewers, water works, etc.; and the largest annual expenditures, except for education, are for maintaining and operating such works; and councilmen who, for political or personal reasons, put incompetent, non-technical men in charge of the city's public works are robbing the taxpayers of much more than merely the salaries paid them. Even if such appointees do not waste the funds appropriated, they can not be expected to obtain from the works in their charge the service that the citizens should receive from them. And in many a case actual loss of life—many lives—can be traced to their incompetence.

Work for State Municipal Leagues

The financial well-being of the farming population of the country has been receiving the consideration of the Federal and State governments as never before, and one result of this has been a tendency to lose sight of the needs and rights of the cities, which also have had their financial troubles; which troubles are likely to increase with the withdrawal of Federal aid in unemployment relief. In this emergency it behooves the cities to cooperate in demanding consideration of their necessities; and in effecting this, the State municipal leagues have an opportunity for real service.

The executive secretary of the West Virginia League of Municipalities, Hume K. Nowlan, in his New Year's bulletin, outlines the activities which he believes that league should undertake this year. These are:

"1—To establish and maintain informal contacts and working relations with the State government.

"2—To do preliminary research disclosing the true effect of existing laws upon the finances of cities.

"3—To disseminate factual data concerning the plight of cities in arousing public opinion to appreciate municipal needs.

"4—To justify the claim of cities for sufficient funds from revenues already being collected to restore and maintain essential municipal services.

"5—To open and develop channels of communication between cities, large and small, for the exchange of information and experiences of mutual benefit.

"6—To generate the realization among city officials that only by presenting unquestionable solidarity of front can destructive anti-urban trends be offset and overcome.

"7—To carry out an in-service training school program susceptible to expansion as interest in improving the technical aspects of municipal administration spreads.

"8—To assure fair treatment of cities in the future by means of an electorate enlightened as to the part played by urban dwellers in the fiscal affairs of the state government.

"9—To arouse awareness that League services are invaluable—to bring about a general realization that the League is an irreplacable agency in municipal administration.

"10—To encourage municipal cooperation to the end that League work will be carried on with vigor and forcefulness during 1936 and future years."

We recommend this program to other municipal leagues. Undoubtedly many cities have been indulging in extravagances that should be suppressed; but more have had their incomes reduced and their compulsory expenditures increased by State legislation which should be changed; and legislators pay little respect to *unorganized* demands, even though they represent the wishes of a majority of the people.

Equipment Used in Water Purification

Handling Chemicals

Dry Feeders (Continued)

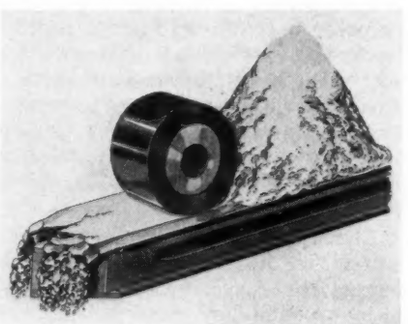
IN the Savage-Gauntt feeder, the chemical flows from the hopper to a screw conveyor which is operated intermittently, by which the rate of feed is controlled, and which delivers the chemical to another screw conveyor which feeds it continuously to the mixing chamber.

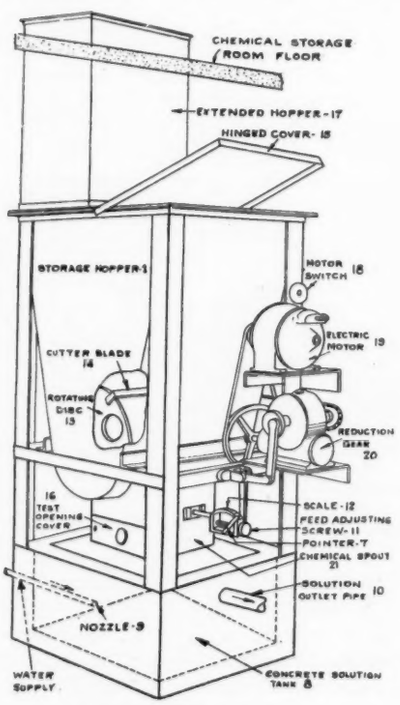
Wallace & Tiernan feeders discharge the chemical through the oscillating feed spout onto a plate, adjustment of feed being effected by varying the stroke of this spout. Continuous flow from this plate is obtained by a "free wheeling" feed roll, a roller which pushes a ribbon of the chemical off the plate at both forward and back strokes of the spout and facilitates feeding of damp lime and other difficult materials.

Infilco feeders are of two types. In one the chemical is discharged onto a revolving table, part of which projects through a slot as in the Omega disk, but the principal regulation of feed is obtained by varying the depth of cut of the scraper into the revolving chemical. In their type M feeder, the rate of flow of chemical is controlled by a shutter gate at the bottom of the hopper, just above which is an oscillating plate to keep the material moving, and below the gate is a revolving feeder spool with radial pocket-forming vanes which withdraws the material at a uniform rate and discharges it into the discharge chute.

Feeding by weight instead of by volume has some advantages, including greater accuracy. The Omega Machine Co., makes a "gravimetric feeder" which it claims will feed, with a variation of less than 1% (most makers claim "less than 5%" for volumetric feeders), from 10 to 5,000 lbs. per hour. In this the hopper is supported on a scale mechanism, and each time it is filled the scale is balanced manually. A rate control synchronous motor, by means of a micrometer screw, moves the poise slowly backward at the precise rate for which it is set. If the chemical is being fed at a lower rate, the scale beam moves upward, which operates through a system of levers to speed up the operation of the feeding mechanism; if the rate exceeds that desired, the feeding is similarly slowed up. An alarm is rung when the hopper is nearly empty or if the feed is not continuous at the desired rate. This is a new device, and not more than five or six are yet in use. It occupies a space 3 x 4 ft. by 5 ft. high for the smaller size, and 4½ x 5 ft. x 7½ ft. high for the larger.

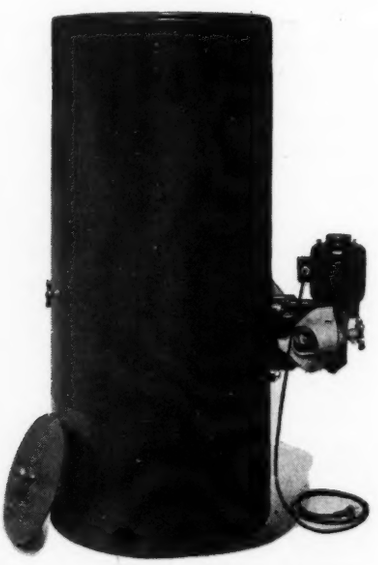
The feeders discharge into a mixing chamber, which is often variable according to the chemical in use. In the Omega, this is a circular chamber of heavy steel lined with asphalt and cypress, receiving water through a jet which provides agitation. In the Savage-Gauntt, the chemical is brought into solution by passing the intake water over and under a series of baffle plates in the mixing chamber; solid lead being used for the mixing chamber for alum and other acid solutions. In the Bacharach, water enters a 15 x 25 in. solution tank through a nozzle that produces agitation, the tank being lined with vitreous enamel for corrosive chemicals. Wallace & Tiernan provides a mixing chamber of glazed earth-



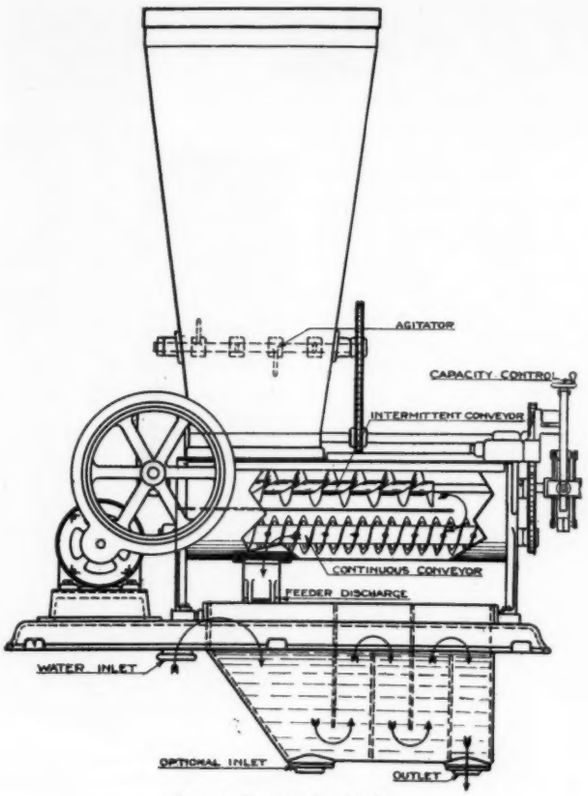


Bacharach Type S dry feeder
(See January issue)

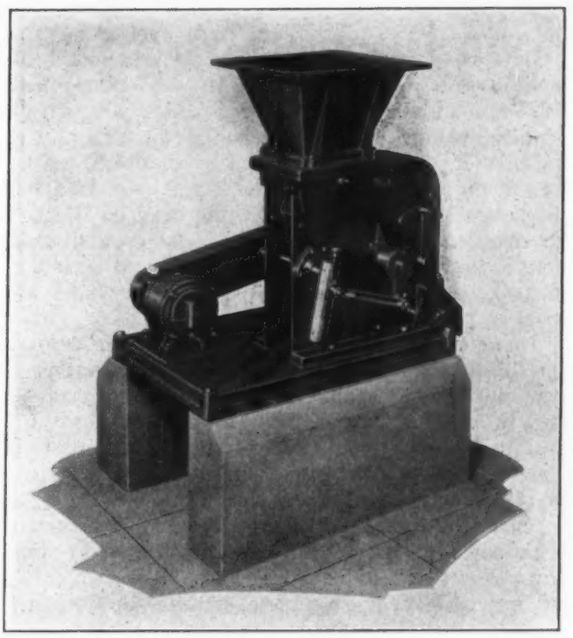
Patterson mixing unit to be attached to ceiling
(See January issue)



W & T dry feeder. Above "free wheeling" feed roll



Savage-Gauntt dry feeder



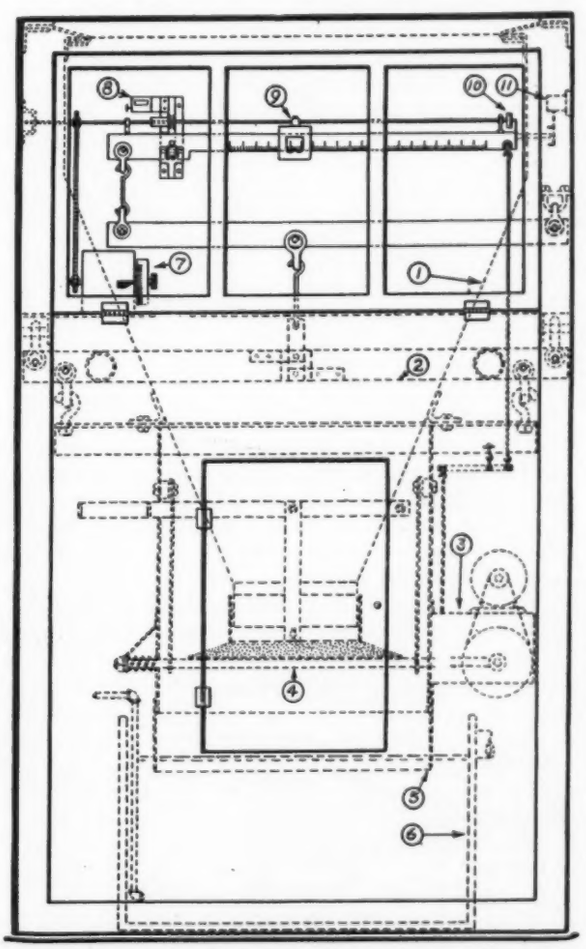
Infilco dry chemical feeder type M.

enware, into which water enters from a lead pipe and a special deflector produces great agitation, with a water consumption of 3 to 8 gpm. Infilco feeders have a "vortex" mixer, which consists of an inverted cone shaped bowl into which the water enters tangentially, leaving at the bottom.

Lime slakers combined with the feeders are furnished by two or more firms, removing the need for weighing and slaking the lime in batches and agitating, before feeding. The Infilco consists of a type M feeder (see above), water control, slaker, dust and vapor remover, and grit and stone remover. The volume of slaking water should be proportional to the amount of lime fed, and this is effected by adjusting the water valve to correspond with the lime feed rate The slaker tank, with size to give 30 min. retention at maximum capacity, is of welded steel, half-round bottom, with agitator blades revolving slowly around a horizontal axis. A steel plate extends below the water line to prevent short-circuiting from inlet to outlet. Dust and vapor are ejected by a water jet dust remover. The mixture passes out over a weir and through a revolving grit screen, where it is diluted to the desired milk of lime consistency. Cups on arms at the end of the agitator shaft pick up grit and other foreign matters from the bottom of the tank and discharge them into a grit chamber. These slakers can be adjustable by hand, or varied automatically in proportion to the amount of water being treated. Capacities vary from 175 to 4,000 pounds of quick lime per hour; the smallest occupies a floor space of 2 x 8 ft.; the largest 5 x 11½ ft.

The Omega lime slaker receives the lime by gravity direct from a "Universal" feeder. A nearly vertical shaft revolves a small two-blade impeller in the slaker tank, which also receives a powerful jet of water; the two agitating the entire content and producing a scouring effect. The water supply is changed automatically with the lime feed. Dust and vapor are removed by an eductor operated by water jets. Stones and clinker can be hoed into a clinker pocket. The slakers are insulated to retain the heat. Capacities, 25 to 4,000 lbs. per hour.

Lime should not be slaked in tanks made of concrete, for the heat created by slaking may crack them.



Omega Gravimetric feeder—standard construction, without accessories such as lime slaker, mixing chamber, extension hopper, dust removal unit, etc.

Solution Feeders

Devices for measuring the chemical in liquid form make use of several principles. In one type a constant head is maintained on an orifice; either size of orifice or head being changed to change the rate of feed. In another, the rate is adjusted by changing the head on the end of a submerged discharge hose. In a third, discharge is through a siphon, the head on which can be changed at will. Or the free end of a discharge hose is lowered by a mechanical device at such a rate as to keep it at a constant distance below the water level in the tank.

In other devices volume measurement is employed by dipping the solution out with a cup, either cup contents or rate of cup discharge being variable. Or the solution is forced from a tank by lowering a weight into it at the desired rate. Or the solution is pumped, the rate being varied by changing length of stroke or number of strokes per minute.

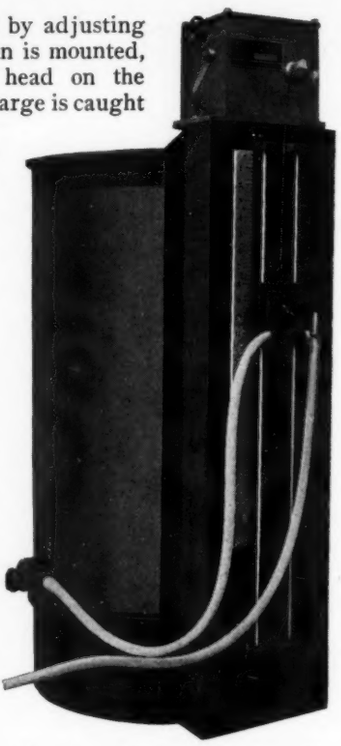
In all of these, the liquid measured is assumed to have a uniform strength, which is secured by mixing known amounts of chemical with measured amounts of water, securing complete solution and, if necessary, maintaining uniform strength by constant agitation. It also is necessary to prevent any undissolved or other solid particles from reaching the feeder, as they might affect the accuracy of measurement or even clog the discharge tubes.

Where the flow is through an orifice or a hose, this must be kept free of any deposits or of corrosion, which would alter the size. In the case of pumps of the plunger type, both packing and plunger must be of material that will not be affected by chemicals. In diaphragm pumps, the displacement caused by the flexing of the diaphragm may vary with the age of the diaphragm and the pressure against which it operates. Frequent renewal of diaphragm is indicated.

In the International solution feeder, a constant head is maintained on an orifice by means of a float which regulates the opening of the chemical inlet. The outlet orifice is formed by a rectangular opening near the bottom of each of two vertical rubber tubes, one of which fits closely inside the other; by turning the inner tube (with micrometer adjustment) its opening moves across that in the outer tube, giving the net length of opening desired.

In the "Omega precision" feeder, one end of a hose is connected to the bottom of a tank and the other or outlet end is set at the level of the liquid in the tank, and is then lowered at the desired rate by means of a small Telechron motor; the liquid in the tank meantime flowing out through the tube and its surface falling at the same rate.

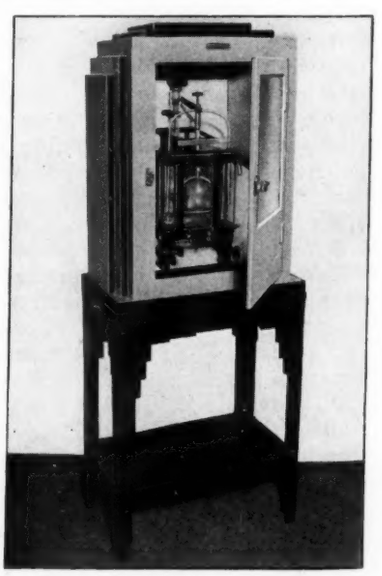
In the Phipps & Bird feeder (designed especially for feeding small quantities of corrosive liquids), variation of flow is obtained by adjusting a float on which a siphon is mounted, thereby changing the head on the siphon. The siphon discharge is caught in an outlet funnel so constructed as to keep the siphon primed during shut-off periods. The normal rate of feed is 45 gallons per 24 hours, but smaller-capacity feeders can be furnished.



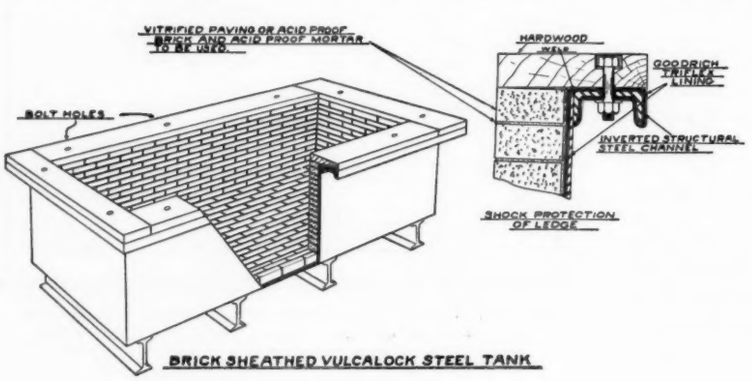
Omega precision liquid feeder with telechron motor drive and 10 different rates of speed.

In the Geary feeder a cup is dipped into the liquid, raised, tipped and partly discharged into the feed line; the amount by which the cup is tipped (which is adjustable) determining the rate of dosing, which can be varied from ½ cc. to 1300 cc. per minute. The cup is raised and lowered by means of a rod connected to a pin on a revolving arm at a distance from the center of revolution which is adjustable and determines the amount of tipping of the cup.

The Hills-McCanna feed pump is a plunger pump, in which the length of stroke can be varied so as to reduce the discharge to a single drop; operated by a ¼ h. p. motor or belt drive. The Duriron is a vertical plunger pump in which all parts coming in contact with the liquid pumped are made of duriron; the length of stroke is adjustable from zero to 4 in., maximum discharge for one revolution of the crank shaft 0.1 gal. A Duriron horizontal piston pump is made with a capacity of 1.2 gal. per revolution, not adjustable. In the Dearborn chemical pump the plunger and cylinder are interchangeable from ½ to 3 in. diameter, and the stroke is changeable while operating from zero to 3 in., operated by electric or water motor, reciprocating motion or belt drive.



Below — Rubber-lined steel tank. (See January issue, p. 26). At right — Phipps & Bird solution feeder



Use of Rollers in Bituminous Pavement Construction

By H. S. Perry

Ass't. Chief Engineer, Bureau of Maintenance, Ohio State Highway Dept.

IT IS the writer's firm conviction that, whatever the type of pavement under consideration, the proper use of suitable and efficient rolling equipment constitutes the major reason why any particular job of bituminous paving is a superior rather than a fair or poor one—not only immediately after construction but also in years to come.

In constructing bitumenized waterbound and bituminous penetration pavement, almost any crushed aggregate may be used and splendid results obtained if proper rolling manipulation be employed, the bitumens chosen being suitable to the aggregate used. Naturally, the softer aggregates should receive less rolling and a higher percentage of bituminous material than those that are hard and tough, whether used as surface treatment material or in penetration work.

Necessity of Proper Rolling

Many a job has resulted in warped surfaces, surface disintegration and high maintenance cost largely as a result of incorrect rolling. And many a job has been spoiled by too rigid an adherence to a definite rolling requirement without giving proper attention to the determining characteristics of the materials used in construction. But with either of the types named, using a maximum of about 50 pounds of dragged leveling bituminous treatment per square yard, it should be easy to build a pavement so true that, should it later be desired to apply a first-class pre-mixed bituminous top, no extra binder would be required for leveling purposes.

The roller has played an important part in the development of the various types of both hot and cold bituminous pavements. Using a perfectly balanced heavy roller—10 to 12 or even 15 tons—to a lay a one (or preferably several)-course hot or cold binder type of pavement, with the base considerably coarser than now is commonly used and with the top binder essentially the same as now employed, each course being finished independently, and a surface being applied consisting of 40 to 60 pounds of native rock asphalt of high bitumen content or equivalent material well placed, all courses rolled with the same heavy roller; and the result will be a pavement with extremely high interlocking stability, long lived, industrially and commercially appealing, esthetic, and less costlier, though superior to, a two-course sheet asphalt.

Many types of bituminous pavement, both proprietary and open, have been developed, differing in aggregate and binder as well as in the methods of combining them. And the most effective rolling requirements differ with each of these differences, especially those in the binder. As good results can be obtained with cold mix cold-lay types as with hot mix, if reliance be placed not alone on the liquefier but even more on proper rolling. Success requires interlocking stability, for which a heavy roller is imperatively necessary. If a coarse binder with less than 0.5% of liquefier be used, the very small amount trapped will not be injurious if the rolling has been effectively completed; in fact, it is more apt to be beneficial as a carrying agent in years to come.

The use of cutback as a solvent in cold mixes requires a wide variation in roller operation. There is a wide difference in the curing range between a low-end-point naphtha and a slowly volatilizing kerosene, and roller manipulation must be governed accordingly. Failure to do so is frequently the cause of waving of the surface under traffic. Slowly volatilizing cutbacks require light initial rolling and frequently a delay of even this; and such jobs must always be nursed, and light rolling is desirable in rainy weather to prevent surface emulsification and consequent loss of bitumen. The use of low-end-point naphtha solvent, on the other hand, requires prompt and heavy rolling, as also do emulsions, which break and set quickly.

Other factors to be considered are ground temperature, both daily and seasonal, and time in transit as affecting temperature of the mixture when laid. These can generally be so coordinated by daily regulation as to maintain fairly constant and uniform the temperature established for the mix when rolled. As transit time cannot always be controlled, it may be necessary to base upon this the selection of type of construction. If daily temperatures vary widely, the mixture can be rolled promptly as spread, or after a delay of a few hours or even days.

It is questionable whether a light roller is ever desirable, even with slow-curing cutbacks, instead of delayed heavy rolling. Traffic, acting year after year, will find any spots which have not been thoroughly compacted by rolling, and if there are any pockets of trapped liquefier or solvent it will find them. The required roller concentration therefore should exceed future tire concentration per square inch, allowing for traffic impact stresses, which stresses cannot be eliminated.

Rolling Equipment

It has been the aim of manufacturers, in developing the roller, to eliminate vibration, stop-thrust and horizontal thrust (shoving), secure continuity of operation and an adequate, single-plane pressure.

The gas roller, though eliminating delays due to taking water and fuel, has found it quite a problem to equal the smoothness of the steam. (Fuel cost is not a large item in roller operation.) Vibration is inimical to good workmanship, whether due to fuel, construction or other cause. Balance of design has been gradually perfected by the leading manufacturers, the States having contributed by specifying weight distribution; which distribution can easily be thrown out of balance by improper placing of water ballast tanks. Operating visibility is necessary for safety as well as efficient roller manipulation and should obtain in a high degree. Reversing of direction should be done through a friction clutch rather than change of gears, to avoid the jerk which will leave its mark on the pavement. None of the rolls of the three-wheel roller should cut the surface on either side, and the rear rolls should lap at least

4 inches over the front one. Design speed should be limited to a maximum of three miles per hour for efficient workmanship. All rolls should be equipped for water.

Perhaps the most significant development in roller equipment construction is the third axle. It produces concentration far greater than heretofore obtainable in tandem operations, its success depending on the ability of the designers to prevent horizontal thrust and of the pavement designers to eliminate the necessity of cross or diagonal rolling.

The approximate number of rollers in use in the United States is 12,750, of which 1,450 are in New England, 1,150 in Pennsylvania, 1,100 in New York, 800 in California, 750 in Ohio and 7,500 in all the other states. About 1,500 have been exported.

There are but two functions of pavement rolling—securing stability, and incidentally reducing the voids and consequently increasing pavement density; and producing a smooth-riding surface. Around these two functions the various rolling requirements of specifications are being written.

No roller can produce good results without uniform distribution of mixed materials in advance of any rolling—the roller is not designed to serve as a spreading machine. Rolling should progress from the side toward the center, paralleling the center line; and the steering roll should always be in the rear on the two-axle roller.

Roller specifications of the several states contain 22 items, principally pavement operations. Ohio covers the field most thoroughly, for the bituminous types specifying 10 to 12-ton, three-wheel or tandem rollers. Some of the states still permit the use of 5- and 6-ton rollers in certain items in the construction of both hot and cold pre-mixes. It is the writer's opinion that cold pre-mixes should drift toward heavier rollers than should the hot pre-mixes. The hot pre-mix would develop a relatively high degree of stability without rolling, due to binder characteristics, this type of construction of course, being an asburdity. Whatever the cold pre-mix, subscribing to the low liquefier content and other conditions as before recommended, or carry readily volatile solvents, it will require high initial roller pressure to secure intimate adhesive contacts before any bituminous set can occur that might cause aggregate arching and an accompanying decrease in its interlocking stability, with an accompanying lower initial and ultimate lessened bituminous adhesion. Rolling of this type after set serves naturally to increase density, but at the almost certain cost of stability, due to the friction of aggregate against aggregate and the consequent lessening of the bituminous bond.

Ohio has, perhaps first among the states, developed a very comprehensive roller specification, due largely to the energy of one man, H. A. Sparks, Hot-Mix Engineer of the Ohio Highway Department. Ohio is giving, and rightly so, a great deal of attention to rolling and roller-hours. But along with any such specification must go an understanding interpretation, based on a knowledge of the type being constructed, and the character and nature of the materials therein incorporated, if intelligent inspection is to obtain and a good job be secured. The various bituminous types should be easy to build properly:—there is nothing particularly mysterious about bitumens; yet the density of inspectors on such types is only too frequently the reciprocal of the desired density of the pavement itself, the remedy for which is quite apparent.

The above is abstracted from a paper by Mr. Perry before the 1936 meeting of the American Road Builders' Association.

Economics of Sludge Disposal Methods

Under the title "The Economics of Various Methods of Sewage Sludge Disposal," A. J. Fischer, of the Dorr Company, presented an excellent discussion of the subject before the New York State Sewage Works Association. The summary and conclusions are given in the following paragraphs:

1. An economic study has been made comparing installation and operating costs of various methods of sludge disposal where primary, trickling filter, chemical and activated sludge treatment are used.

2. Peak sludge loads are a very important factor and must be taken into consideration, especially where raw sludges are filtered and incinerated direct. In such cases, a two day sludge storage or thickening period is advisable, and excess filter and incinerator capacity may have to be furnished to handle 300 to 400% of the daily average dry solids load.

3. Lowest plant installation costs are obtained where the sludge is digested prior to dewatering on vacuum filters, except in the case of activated sludge treatment, where filtration of the combined digested primary and undigested activated sludges gives the lowest first costs.

4. Highest first costs are obtained for raw sludge incineration where 375% peak loads are assumed. For plants of over 10 m.g.d. capacity raw sludge incineration first costs using only 125% peak loads (the same as has been assumed for digested sludge) are higher than those for digested sludge filtration. They are slightly lower, however, than for digested sludge incineration or where mixed digested primary and undigested sludge is incinerated.

5. Operating costs are lowest for plants of less than 10 m.g.d. capacity where open sand drying beds are used. In general, for plants of over 25 m.g.d. capacity the costs of digested sludge filtration or filtration and incineration are lowest.

6. Operating costs of raw sludge incineration plants are highest even where high peak loads are not assumed.

7. In the case of activated sludge treatment the desirable procedure from an operating cost standpoint is to combine the digested primary and the thickened undigested activated sludges prior to filtration or filtration and incineration.

8. Operating costs may be reduced considerably in the case of digested sludge handling by resorting to lower digestion periods (20 days) and by using the Genter elutriation process.

9. Future trends appear to be in favor of vacuum filtration of sludges in the smaller plants with a possibility of drying the sludge for local marketing as a fertilizer. In the larger plants, sludge incineration will find a more widespread application.

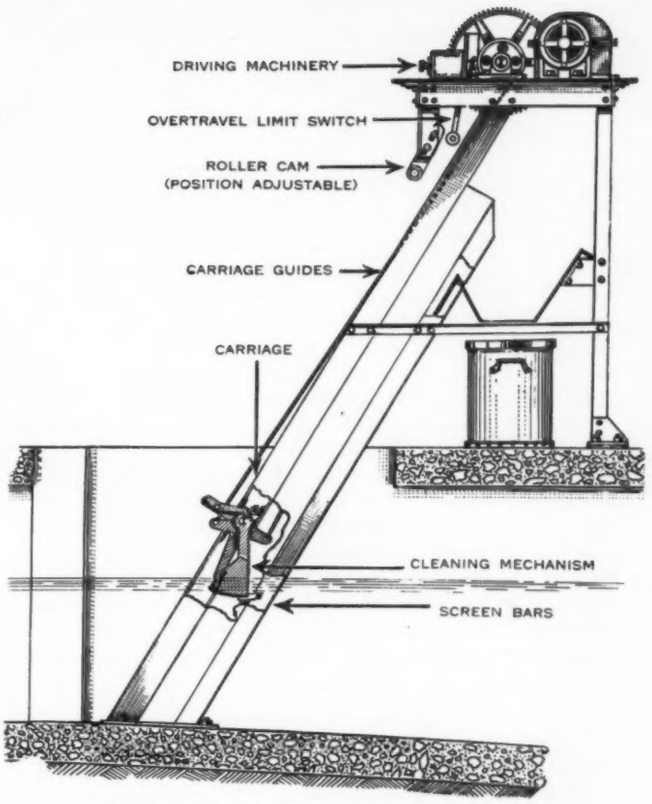
10. The results and conclusions arrived at in this paper are based on the exact conditions and costs as noted. They are not intended to cover all conditions in general. Each specific problem must be analyzed on its own merits, taking into consideration the various influencing local factors.

Fees for Refuse Collection in Huntington

Huntington, West Virginia, has inaugurated refuse disposal on a fee basis. Rates are to start at extremely low figures, $3.50 per year per family and $15 per year for each store or business for weekly service. Daily service will be provided for $60 a year. Fees are to pay the cost of collection service and to amortize expenditures for equipment and a new incinerator.

Lubrication of Sewage Treatment Equipment

Mechanization of sewage treatment equipment has resulted in a wide use of machinery, including pumps, screen cleaning equipment, agitators, sludge collectors and clarifiers, filters, motors, engines, etc. A study was recently made by The Texas Co., and a report published by them in "Lubrication," from which the following data are abstracted. The editors will be glad to help readers in getting a complete copy of this report.



The Link-Belt Mechanically Cleaned Bar Screen

CONDITIONS of operation in many sewage disposal plants will require careful protection of lubricants if they are to function effectively. Moisture or the possibility of actual contact with water and acids present are especially aggravating conditions which may materially affect the performance of certain types of lubricants.

Temperature must also be considered; normalcy from two angles, i.e., the extent to which high bearing temperatures might result due to presence of abrasive contaminants in any of the lubricating systems, which would lead to scoring, metallic friction and impaired lubrication; and the possibility of certain of the operating mechanisms having to function under comparatively low water temperatures.

It is important to remember that the only way in which high temperatures may develop in a disposal plant is through friction. Conversely, in the case of parts subjected to continued low temperatures, impaired lubrication may be caused by reduction in the fluidity of the lubricant, which may prevent it reaching the parts to be lubricated.

Both the pour test and relative viscosity must be considered when selecting a lubricating oil for this type of service. The former is perhaps the more positive indication, and if it shows that the oil in question flows at around zero Fahrenheit, the possibility of impaired lubrication will be remote. When considering grease for low temperature work, both the pour test of the oil component and the structure of the finished product are important. Obviously, the oil should have at least a zero pour test. In turn, if the grease is of "short" or relatively buttery consistency, it will have the least tendency to become so heavy as to be incapable of delivery to the bearings.

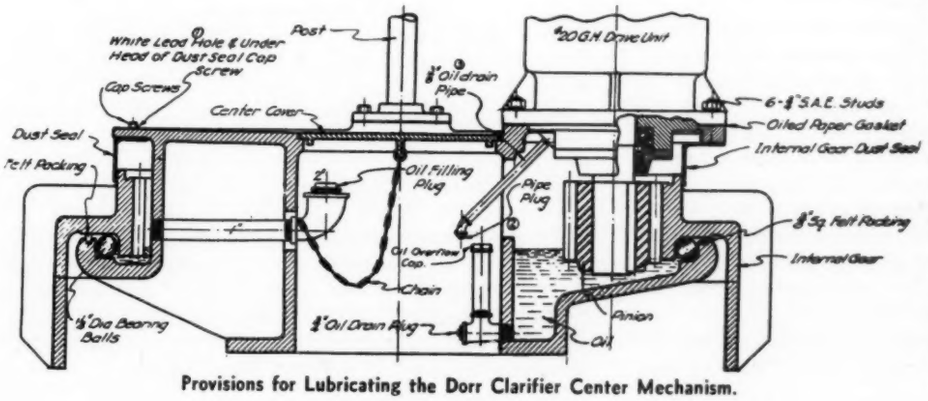
Clarifier and Sludge Collector Mechanisms

Lubrication of these is confined to the top-side driving parts; all submerged mechanisms receive adequate lubrication from the oily matter present in the sewage or sludge. Electric motor power is customarily used to operate the collectors, with suitable gear reduction to develop the very slow motion necessary. In addition, some devices may require a flexible chain connection from the main drive.

Due to the exposed location of these mechanisms, they are normally very tightly housed which is an adjunct to effective lubrication, and conducive to the use of comparatively fluid lubricants which will function positively with minimum drag over a wide range of atmospheric temperatures.

Screen Cleaning

Chain or bar conveyor elements, as applied to screen cleaning equipment and other devices, will be exposed to severe moisture conditions and the possibility of considerable contact with non-lubricating foreign matter. To a large degree, the builders of such equipment have anticipated these conditions and designed their bearing housings and chain-link mechanisms in such a manner as to prevent direct entry of foreign substances.



Provisions for Lubricating the Dorr Clarifier Center Mechanism.

Cost of manufacture normally prohibits the use of absolutely tight sealing media, however, so it devolves upon lubrication to serve as a metal protective as well as a means of preventing abnormal friction.

Chain and Sprocket Mechanisms

Endless chain conveyors and bucket elevators require sprockets to keep the conveying elements in position. It is generally unnecessary to consider lubrication of the sprocket teeth for they are functioning continually in a water bath. Chain or bar link mechanisms, however, or the bearings which carry the buckets must often be carefully lubricated with a water-resistant grease to prevent entry of abrasive materials which would promote bearing wear.

Research in the manufacture of insoluble greases has progressed markedly over recent years. It has been fostered by the necessity for more positive water pump lubrication on automotive engines, and for gate mechanism protection in the hydraulic turbine plant. This latest requirement, as presented by the mechanized sewage disposal system, has further justified these activities in grease research. The results of this work have been especially interesting in view of the wide temperature range to which such greases are adaptable and their ability to withstand the washing action of water to effectively prevent foreign matter from working into bearing clearance spaces.

Conveyor Mechanisms

The usual rough service to which conveyor mechanisms may be subject requires careful consideration of their maintenance and upkeep. Due to their rugged construction many conveyors will continue to operate irrespective of the care received, the loads applied, or the manner in which wearing parts are lubricated. Operation of a conveyor, however, requires power, and it is amazing how power consumption will increase if operating conditions are unfavorable and frictional resistance is allowed to build up.

There will always be a certain amount of friction between the bearing surfaces, rollers, chains, sprockets, and gearing, with more or less resultant wear. Fortunately, friction and excessive wear can be reduced by effective lubrication.

Blowers

Blower operation must naturally be positive and frequently continuous. All bearings and gear elements must therefore be adequately lubricated. The ring-oiled bearing predominates in many plants, along with a type of gear case which permits of bath lubrication. In this way, constant circulation of comparatively light viscosity oils is an adjunct to reduced power economy and maintenance of safe operating temperatures. Cooling in addition to lubrication is important in the operation of such machinery where fairly high operating temperatures may arise at times due to the constant type of service.

Gears

Gearing plays an important part in the operation of the motor-driven pump, the blower and certain types of mechanical screens. Where gears are enclosed in relatively tight housings, the possibility of water-entry is greatly reduced. Furthermore, since such construction prevents loss of lubricant to a considerable extent, it is practicable to plan for splash or pressure lubrication and use an oil of medium-heavy viscosity, which will reduce power consumption and facilitate cold starting. The amount of lubricant carried in the case should be in accordance with builders' recommendations and the design of the lubricating system.

Under comparatively exposed conditions, experience has proved that for the spur, bevel or herringbone type of reduction gear a straight mineral lubricant will give best protection. It should contain no filler such as rosin or talc, etc., it should not harden, separate, gum, dry, crack or disintegrate under exposure to varied temperatures, nor become so fluid as to run, drip or throw under ordinary temperature rises. A lubricant of the above characteristics will possess a natural tendency to follow the gear teeth, thus increasing economy to a marked extent by virtue of the decreased frequency of application that is required. This adhering ability will of itself guarantee longer life to the gears by effectively protecting the teeth against wear.

According to prevailing loads the viscosity of such a lubricant should range from that of an extra heavy motor oil to a steam cylinder stock. Manufacturers of worm reduction gears, on the other hand, prefer a compounded lubricant, of the nature of a steam cylinder oil, containing in the neighborhood of five percent of animal fat.

The Value of Tight Housings

The necessity for keeping gear teeth enclosed in comparatively oil-tight and dust-tight housings is important in the interests of effective lubrication and prevention of wear. The most essential characteristics of a good gear lubricant are that it shall have film tenacity and adequate body or viscosity to resist the throwing-off effects of centrifugal force. These very characteristics, however, also render such a lubricant subject to rapid contamination by dust or dirt, if exposed to their influence.

Gears which are exposed either entirely or in part, will require lubricants of heavier body or viscosity than those which are tightly encased. Such a product might range in viscosity from 1000 to 2000 seconds Saybolt at 210 degrees Fahr. This means that more power must be consumed in their operation for the reason that heavy lubricants impose an appreciable "drag" or braking action as the teeth pass in and out of mesh. Furthermore, the heavier the lubricant the greater will be the tendency for it to pick up and absorb dust, dirt or other abrasive solid matter.

Where gears are not contained in an oil or dust-tight housing, weekly application of lubricant is usually customary, although where the gears are entirely unguarded and dust is especially excessive, this period should be decreased somewhat. It must be remembered that a lighter grade of lubricant will last longer and yield better results under such conditions. The heavier grade that would be used under clean operation cannot be expected to maintain an efficient lubricating film under dirty conditions, due to its tendency to accumulate dust. In some cases, it may even be advisable to resort to a very considerable lighter lubricant, but still one of straight mineral nature, having a viscosity of about 200 seconds Saybolt at 210 degrees Fahr., such as an automotive gear lubricant.

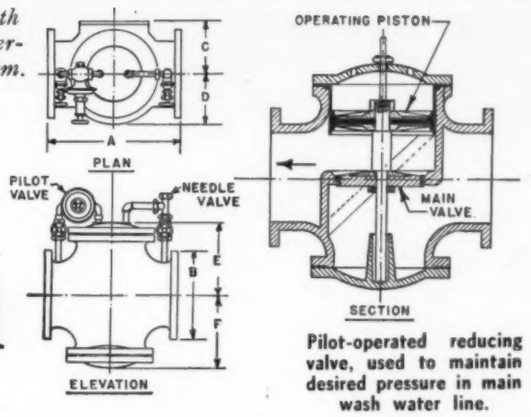
Oil Level Important

It is essential to remember where gears are bath lubricated that the level of the oil must be carefully watched. This will be especially true where heavier lubricants are used, and where there may be a comparatively wide range of operating temperatures, for the development of "drag" or excessive internal friction may become a decided factor in the matter of power consumption.

As a rule, where gears are bath lubricated, it will be well to carry the oil level at such a height as to insure suitable dipping of the teeth of the lower element. Submergence of too much of the gear or pinion is not advisable and, as a general rule, unless comparatively fluid oils are used, it will not be necessary.

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel



Pilot-operated reducing valve, used to maintain desired pressure in main wash water line.

CHECK valves of the old flap type cause appreciable loss of head, excessive wear at the pin and hinge, and water hammer. At a velocity of 7 ft. per second, a tilting disc check shows a loss of just over 0.2 foot, while a standard hinged gate check shows 1.5 to 1.7 ft. loss. Also the former is quicker acting, overcomes slamming, is stable in the open position and has longer life.[A2-13]

Mechanical controls in general use include pressure reducing valves, relief valves, altitude valves and pressure switches. Pressure reducing valves are used to reduce pressure in low-lying districts. Altitude valves are used to maintain a definite level in stand pipes or reservoirs. All three class of valves are very similar except for the way they are connected. When hydraulically operated, they may be controlled directly or through an auxiliary or pilot valve; usually the former for small valves, the latter for those of 4" or over in order to secure greater accuracy. By proper selection of the pilot almost any degree of sensitive control can be obtained. By connecting a number of pilot valves, several functions can be obtained from one main valve. Automatic pressure switches are used to start and stop pumps, controlled by pressure in main, standpipe, etc.[A2-13]

Rochester, N. Y., was first, it is claimed, to use wrought iron pipe of the kind used (in 1873) in Hemlock Lake conduit No. 1; and the gaugings of this in 1877 furnished the basis of all subsequent calculations on the flow of water through long lines of large riveted pipe. Also the first to install the "Holly system," an independent direct high-pressure fire system; also built in 1873. Also the first to install (in 1877) a telegraph line from the city to its distant reservoir; which was changed to telephone in 1879, when it was the longest telephone line in actual use. Also it has one of the longest rainfall records (since 1873) of any American city, and probably the longest record of evaporation from water surfaces. Also it was the first city to use iodine in its water supply.[A2-14]

Weeds in reservoirs and canals seldom grow if temperature is under 40° or 50° except hardy plants; maximum growth above 60°. Lily pads grow in depths of 10 to 20 ft., others at 5 ft., etc. Some continue to grow, others die, if water recedes. Chara grows in depths from a few inches to 15 ft. if the water is very clear. Few weeds flourish where there is much wind. Most prefer a silty loam soil or sand. Some types grow only in moving water, others in comparatively still water. Chara gives water noticeable taste and odor, most weeds do not.

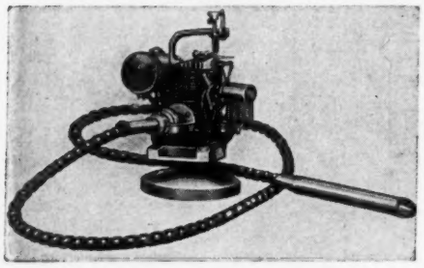
For weed control, copper sulphate is better than other chemicals, but loses its effectiveness in a few hours. Two pounds per million gallons applied continuously to incoming water has proved effective; intermittent dosing produces little or no effect. Practicable doses may be ineffective in killing grown weeds of some types but prevent new growths. Cutting and pulling weeds is very effective. One of the best methods is by rapid varying of water level. Another, burning weeds on exposed shores when water is low, or cutting and raking them from the water. For tastes, the best remedy is activated carbon; aeration also may help.[A2-3]

Ortho tolidin test for chlorine was interfered with in Toronto by algae, and from an investigation it was concluded that "under certain conditions the presence of algae may cause a very distinct interference with the ortho tolidin and starch iodide tests for the presence of free chlorine in water. The definite reason for this condition cannot at this time be accurately reported, and further work is to be carried out. Two possible factors, which may be the same factor, however, appear to be involved: (1) A straight reaction between the coloring matter in algae, and the chemicals used in these tests. (2) An oxidation of the testing solution brought about by the presence of atomic oxygen. The fact that both ortho tolidin and starch iodide react similarly strengthens this contention. The removal of the oxygen from the plant by sodium thio-sulphate also causes a negative reaction, but this returns when the plant is allowed to stand in sunlight."[A2-9]

Prefiltration of river water is practiced at Brantford, Ontario, when spring floods give it high turbidity and color. The sod has been removed from about an acre of farm land adjacent to the filtration plant and underlaid with 10 to 15 ft. of coarse gravel; in which collecting tiles have been laid about 8 ft. deep and leading to the suction well. Raw water is pumped onto this area, passes through the gravel to the well, is coagulated and filtered through rapid sand filters. After passing through the ground, no turbidity and very little color remain, and the amount of alum needed is greatly reduced, the average dose during 1934 being 0.47 grain per gallon. The cost of chemicals for the year, including alum, Nuchar and chlorine, amounted to $1.68 per million gallons, or about one-fifth what would have been necessary without the ground prefiltration.[A2-11]

Purification chemicals at the Saginaw, Mich., water plant—lime and soda ash—are carried to the point of application in open troughs, which permits continuous observation to learn of encrusting in the conduit and cleaning out same without removing it from service.[U2-1]

MALL CONCRETE VIBRATORS
GASOLINE ENGINE ELECTRIC



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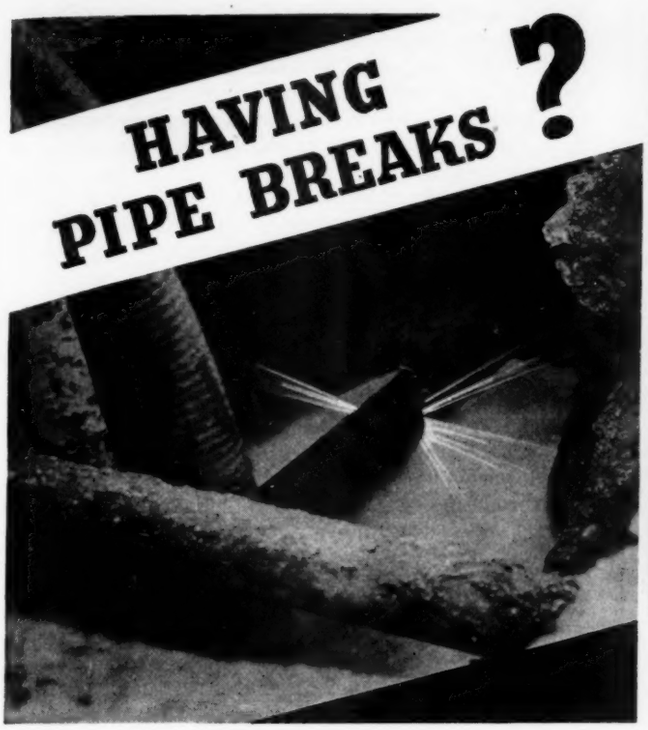
Filter sand specifications more explicit than heretofore require that for a sand bed of 24 inches there shall be 20.4 inches of sand less than 1 mm. diameter and 3.6 inches between size of 1.0 mm. and 2.0 mm. diameter. The depth shall be determined by measuring point 24.0 inches above the top of the gravel. The bed shall come to this height after being washed in the usual manner to expand the sand bed at least 30 per cent, and then cutting the wash water off slowly—the time of closing the wash water valve shall be not less than 30 seconds nor more than 60. Newer definitions of effective size state that the effective size shall be determined by averaging the 1, 2, 4, 8, 16 and 32 per cent diameters, except that the maximum diameter considered shall be not more than 1.5 times the 1.0 per cent diameter. Should 1.5 times the 1.0 per cent. diameter give a diameter less than the 32 per cent diameter, take all of the diameters mentioned which are less than this figure and average. Then add all of the diameters less than the figure together with the diameter next greater than the figure and average. After determining the two averages, compute the effective size proportionately between the two averages. The percentage of material finer than 1.5 times the 1.0 per cent diameter is called the uniformity coefficient. [G2-2]

Trend of water treatment is (1) to more carefully prepare the water for treatment; (2) increased use of mechanical treatment for mixing, flocculation and continuous removal of sludge; (3) study of the part that the upper sand layers play in filtration and methods of cleaning those layers; (4) further developments in the use of filtering materials other than sand; (5) increased use of the ferric-iron salts in coagulation; (6) a more careful study of the causes of tastes and odors. 1935 is definitely labelled as a year of water supply progress. The growing use of air conditioning is increasing the water consumption in all sections of the country. A greater interest in corrosion control and in pipe linings is being displayed. [G2-1]

Hydraulic symbols and terms have been compiled by a special committee of the Am. Soc. of Civil Engineers, beginning in 1927, revised in 1931, 1932, 1933 and finally in 1935. Embodies suggestions made by and "is the expression of preference by hydraulic engineers far and wide." The selection and definitions of symbols have special reference to irrigation. Includes 42 symbols and 435 terms. 39 pages. Obtainable from the society at 30 cts. to members, 60 cts. to non-members.



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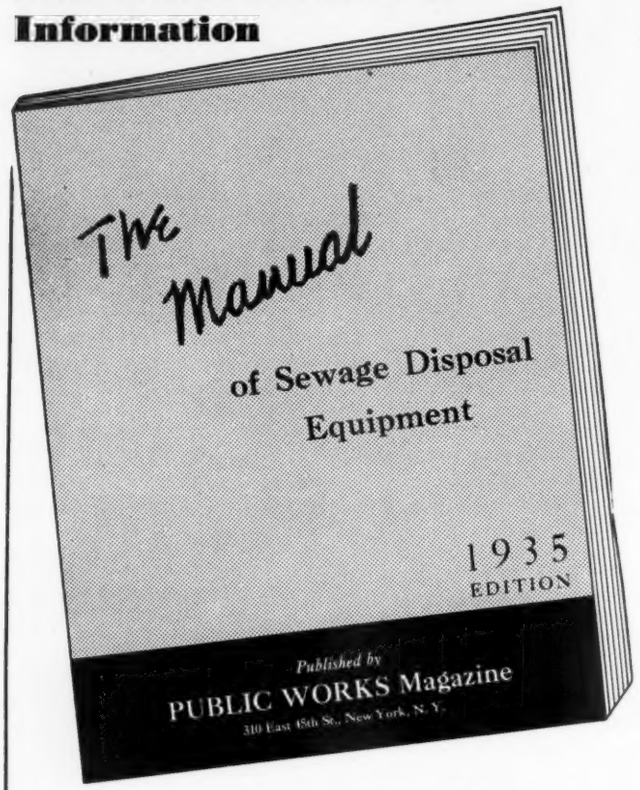

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Water softening plant in Glendive, Mont., obtains soda ash (for lime-soda process) from deep well drilled for that purpose, water of which carries 7.2 grains per gallon of free sodium carbonate and 35.2 gr. of sodium bicarbonate which changes to soda ash when combining with lime. Part of clarifier sludge is now returned to mixing chamber, before which much of the calcium carbonate remained suspended in a state so fine that it passed to filters and clogged them. This no longer occurs; also lime requirements are reduced nearly 10 lb. per hour.[A2-6]

Dam construction equipment being used on Charles Mill dam, Ohio, includes: For rock excavation—wagon drills with 20 ft. steel; jack hammers with air compressor; Timken detachable bits; two 1½-yd. power shovels for loading. For embankment—1½-yd. power shovel at borrow pit; 4 8-yd. Trac-Truks and 2 8-yd. crawler wagons; 2 caterpillar diesels with bulldozers for spreading; 2 sheepsfoot rollers pulled by caterpillar 60's; dragline for cutting toe trench; one sprinkler truck; placed 4,000 cu. yd. in a 15-hr. day. At gravel pit—scraper run by 2-drum hoist; gravel delivered by 40 ft. of 18 in. belt to 32-in. jaw crusher, both run by a tractor; thence 60 ft. by an 18-in. belt to washing screens and sand washer, water furnished by a 4-in. centrifugal pump; produced 400 to 500 cu. yds. a day; handled to bins by a crane with ¾-yd. clamshell bucket. Concrete mixed with 27-E paver for spillway, water furnished by triplex pump; placed with crane using 1-yd. bucket and vibrated with 2 Jackson vibrators.[R2-1]

Bibliography of Recent Water Works Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n,* note or short article;
p, paper before a society (complete or abstract);
t, technical article.

A 2 *Journal, American Water Works Association*

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1. Emergency Work of the Division of Sanitation During the New York State Flood. By A. F. Dappert, pp. 1647-1669.
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6. The Municipal Softening Plant at Glendive, Mont. By C. W. Eyer, pp. 1704-1707.
7. Lewiston's Water System. By W. P. Hughes, pp. 1708-1711.
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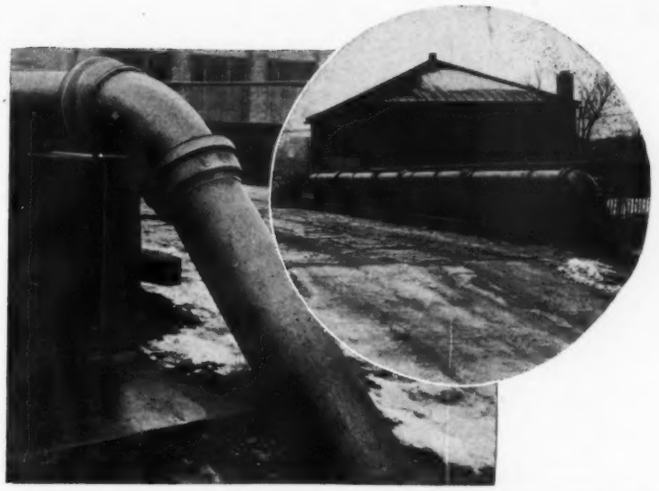

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The Digestion Tank

Digestion tank supernatant is more easily disposed of if taken from a secondary digestion tank, which is not heated. When drawn off and mixed with fresh sewage without preliminary treatment, it may on occasions cause trouble in the sedimentation tank. But by the simple expedient of passing the water through preliminary clinker beds this trouble can be avoided.[D2-2]

A sludge standard is desirable, similar to that set up for sewage plant effluents. Mr. Cotterell "knows of no standard that is in operation that will classify the character of the final sludge discharged from the works, and yet, if nuisance is to be avoided, it is just as important to have a standard for the sludge as it is for the effluent. . . . In dealing with the sludge . . . it is necessary to reduce the water content and also to reduce the amount of volatile matter. It ought not to be difficult to set up a simple standard for the final sludge on the basis of water content and volatile matter content."[D2-2]

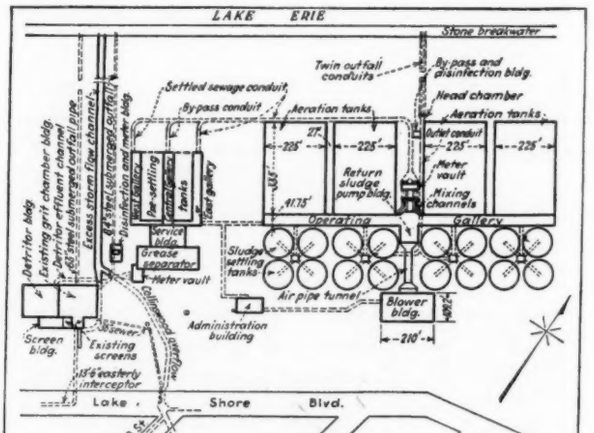
Columbus, O., new treatment plant, of 15 mgd, will be in operation in 1937. It comprises mechanically cleaned bar screens, grit chambers, presettling, aeration and final sedimentation tanks, sludge digestion and vacuum filtration. Grease is skimmed from the grit chambers, and grit removed by bucket elevators and washed. The four presettling tanks are roofed over and the foul air removed from them by the aeration tank blowers. The spiral-flow aeration tanks have, normal to the flow, occasional banks of diffusion plates to provide an air wall for the promotion of mixing; and the piping is so arranged that the operator can introduce raw sewage and return activated sludge at various points to determine the optimum point of application. In the 8 final settling basins, instead of the customary peripheral effluent weirs there are 4 surface skimming weirs, 2 parallel to the flow and 2 at right angles to it, connected at their points of intersection, giving 600 ft. of overflow weir per tank. Excess activated sludge will be pumped to concentration tanks and the supernatant decanted, before it is mixed with the primary sludge for digestion.[E2-2]

Chemical precipitation tests were made at the Grand Rapids sewage plant in 1934 and 1935, with a view to using this in place of secondary treatment during about 6 months of the year when the river is usually low. Ferric chloride was found to be superior to ferric sulphate and alum as a coagulant, and cheaper. It was concluded that the most effective treatment was obtained by the following: dose, 0.75 to 1.5 gr. per gal.—average 1.12 gr.; coagulation period, 15 min.; settling period, 2 hrs. Coagulation gave an increase over plain sedimentation of 47.5% in removal of suspended solids; 41.6% in BOD reduction; and 37.4% in reduction of chlorine demand. In the experimental plant the effluent was passed upward through 3" of sand, which filtration gave increases over the coagulation of 14.4% in removal of suspended solids, 18.7% in BOD reduction and 20.0% in chlorine demand reduction. It is not assumed that as good results could be obtained in routine operation, but an approximation to these would be well worth while.

The cost for treating 24.7 mgd would be $75,000 for plant; $8.22 a day for two additional operators; $85.96 per day for ferric chloride (at $17.40 a ton). There would be a saving of $34.38 in chlorine (a chlorine residual of 0.1 ppm is maintained); there would be 4.37 tons more of fertilizer per day, which sells at $7 a ton, and 70,000 cu. ft. more of gas produced, equivalent to 2,896 kwh. However, no revenue is anticipated from the surplus gas, and sale of one-third of the fertilizer is thought probable. The net cost is estimated at 14 cts. per capita per year.[H2-1]

Catch basins are cleaned an average of once a year in Grand Rapids (some twice), Portland, Me. (some 2 to 4 times), Nashua, N. H. (those at foot of hills 3 times), Milwaukee, Wis., Albany, N. Y. (4 to 6 times at foot of hills), Springfield, Mo. (not often enough). Twice a year in Orange, N. J. (some after every rain storm), Ft. Wayne, Ind. (4 times in low and wooded districts), Berkeley, Calif. (some up to 12 times), Grand Forks, N. D., Terre Haute, Ind., Des Moines, Ia., Syracuse, N. Y., New Castle, Pa., Montclair, N. J., Cedar Rapids, Ia., Concord, N. H. Three times a year in York, Pa. (some 4 times), Gary, Ind., Butte, Mont., Hartford, Conn. Four times in Omaha, Neb. Six times in Mt. Vernon, N. Y. Nine to 12 times in Jacksonville, Fla., Vicksburg, Miss., Hagerstown, Md. After each rain in Iowa City, Ia., Lincoln, Neb., Cumberland, Md. When deposits are 32" or more in Providence, R. I.

East Orange, N. J., has not built sump basins in 20 years and has changed several hundred such to self-scouring inlets which need no cleaning. "In a city with modern pavements we see no excuse for continuing them." Also Wichita, Kans., "does not have sump catch basins on its storm water system. Some that were originally sump basins were filled and new bottoms run in at the outflow elevation, which we find to be a more satisfactory type of basin than the sump type."[H2-5]



General lay-out of Columbus plant

Corrosion of metal in sewage plants is greater from fumes than if submerged. In fact, probably due to lack of oxygen in sewage, metal submerged in it seems to corrode less than if in water. In tests of paints in actual plants, all types of metal primers and finishing coats failed except bituminous enamel applied in two coats, without using any red lead or lead chromate for priming coat. Effects seem to be similar to those on pipe lines that pass through swamp land subjected to results from organic decomposition. Aluminum and other light-colored paints are being tested but definite conclusions are not yet possible.[H2-3]

Sewer pipe equipment for making 24 in. to 60 in. reinforced concrete pipe for Phoenix, Ariz., storm sewer: Two 1-yd. pouring hoppers, each mounted on top of a steel trestle bolted to rear of truck chassis delivered concrete into forms standing 6 ft. high, receiving concrete by backing into a pit under the mixer. Metal forms handled by two small cranes. Sheets for forms, ⅛ in. thick reinforced with 1 x 2-in. channels welded to ends; using 2 Wilson portable welders and a GE welder.[R2-1]

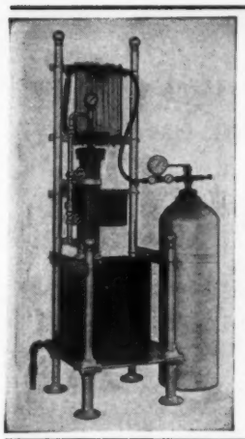
Partial chlorination of sewage effects bacterial reduction, varying with the percent satisfaction of the chlorine demand and the contact time; but this is followed by great increases after incubation. In all cases except when 100% of the chlorine demand was satisfied, growth occurred within 6 hrs. after chlorination, but no counts reached the original numbers until after 24 hrs. of incubation. The greater the initial reduction of *B. Coli* and total bacteria, the longer was the lag, followed by a more rapid increase.[C1-3]

Vertical submerged pumps, when used in shallow wet well for pumping small quantities of sewage or sludge, save in cost of building and installation. Such a pump is excellent while it works, "but it cannot be inspected; repairs cannot be anticipated; it is likely to fail when most needed; must be removed from the well, knocked down and re-assembled for even minor bearing trouble, and is likely to be out of service for some time whenever repairs are made." When used, there should always be a stand-by unit, located in the same wet well as the main pumping unit, or connected with it; and an enclosing building and hoist for raising the pump from the well.

Vertical non-submerged pumps are those most commonly used in modern sewage pumping stations. For 4" discharge or larger, this pump unit does not cost appreciably more than the submerged, but the installation is more expensive and the dry well adds to the cost. Accessibility makes this type more desirable than the submerged pump.

Horizontal pumps in dry well is the simplest form of unit, less expensive to install than the vertical. Danger of flooding must be guarded against. The dampness gives an unfavorable location for motors, and they are not so accessible for operation.

Horizontal self-priming pumps, located above sewage level, "are likely to be most generally used in the future," combining the advantages of the horizontal dry well unit with freedom from damage by flooding, and eliminating cost of dry well. Every part is always accessible. These are comparatively new in the field,



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priming valves having been tested in the field for only five years. Operating costs are no higher and maintenance should be lower. In pumping sludge, suction lift should be kept at a minimum, because gases in the sludge may be liberated under the vacuum created.

Variable speed pumping reduces the detention period of the sewage in the wet well, giving a continuous rather than an on-and-off flow to the treatment plant and permits reducing the size of wet well. The aim is to obtain a pumping rate which will vary in a direct ratio with the rate of inflow to the wet well. The control is automatically actuated by a float switch.[C1-5]

pH adjustment by means of CO_2 has proved promising at the Atlanta, Ga., 0.5 mgd test plant, as a substitute for expensive sulphuric acid. Gas from Imhoff tank vents was burned and flue gases from the burner introduced into the sewage by means of a small blower connected to porous tubes. The equipment was not efficient, but reduced the pH for the 6.9 to 8.4 of the raw sewage to 6.4-6.8.[C1-4]

Bibliography of Sewerage Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article

D 2 — *The Surveyor*
December 20
1. Designs for Storm Water Overflows. By T. Barlow, pp. 703-704.

January 10
2. *p.* Disposal of Domestic Sewage and Trade Waste. By G. T. Cotterell, pp. 43-44.

E 2 — *Engineering News-Record*
January 2
1. Sewage Treatment Trends in England. By K. Imhoff, pp. 8-11.

January 9
2. Activated Sludge Plant Replaces Sprinkling Filter at Columbus, O., p. 51.
3. Cleveland Adds a New Plant to Its Sewage Disposal Facilities, pp. 52-58.

G 2 — *Water Works and Sewerage*
December
1. Menomonee Falls, Wis., Activated Sludge Plant. By R. Cramer, Jr., pp. 418-421
2. *p.* The Patent Situation in Sewage Treatment. By Paul Hansen, pp. 425-426.

January
3. The "Odeeometer"—Its Place in the Control of Activated Sludge Plants. By L. H. Kessler, pp. 13-19.
4. Hourly Load Variations in Relation to Sewage Treatment Plant Operation By E. T. Killam, pp. 26-27.

H 2 — *Municipal Sanitation*
January
1. Interesting Tests on Chemical Precipitation. By N. G. Damoose, pp. 8-13, 28.
2. Outlook in Sewage Treatment. By C. A. Emerson, Jr., p. 14.
3. Corrosion Studies Develop Some Interesting Data. By J. A. Meacham, pp. 15-17.
4. Sanitation District vs. Local Plants. By A. D. Weston, pp. 18-19, 25.
5. Cleaning Storm Water Catch Basins. Discussion, pp. 23-25.
6. An Interesting Experiment in Reducing Plant Odors. By W. J. Schiverea, pp. 26, 28.

J 2 — *American City*
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1. *n.* Locking-Joint Cast Iron Sewer Pipe in Anniston. By H. P. Harris, p. 62.
2. *n.* Sewer Rental Laws in 33 States, p. 77.

L 2 — *Civil Engineering*
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1. Sewage Treatment Experiments at Atlanta, Ga. By M. T. Singleton and G. R. Frith, pp. 767-770.
2. Chemical Precipitation Plant at Birmingham. By H. H. Hendon, pp. 770-771.

M 2 — *Canadian Engineer*
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1. Supplementary Sewage Disposal Project for Toronto, pp. 5-8, 13.

P 2 — *Public Works*
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1. Hints for Winter Operation of Sewage Plants, p. 14.
2. Activated Carbon Aids Sludge Digestion at Liberty. By J. Lawrence and H. Eichenouer, p. 17.
3. Using Paving Brick for Sewer Construction, p. 22.

R 2 — *Contractors and Engineers Monthly*
December
1. *c.* Special Equipment Speeds Pouring of Concrete Sewer Pipe. By J. C. Coyle, p. 19.

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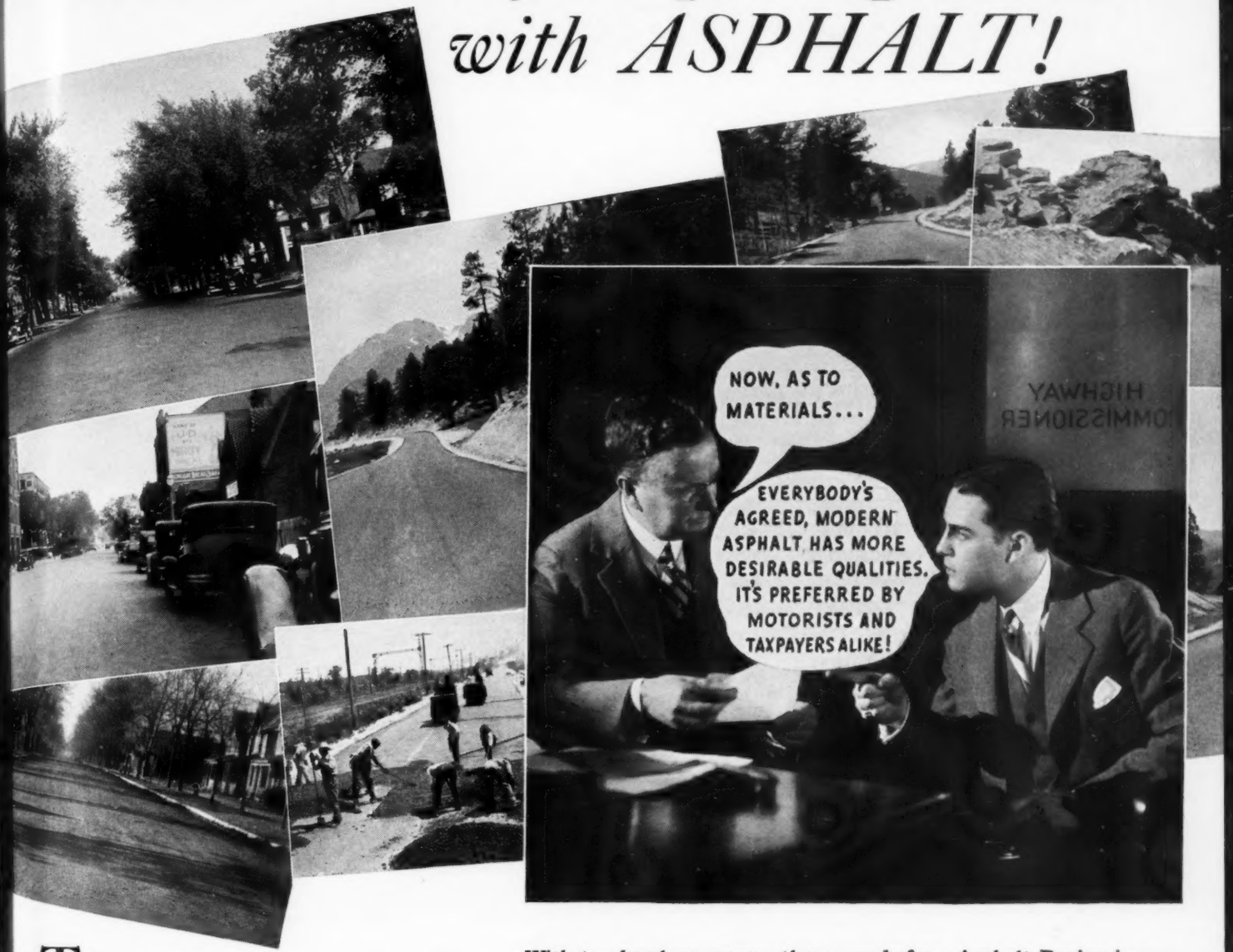

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County Highway Location

Present-day standard practice, considered from safety as well as economic standpoint.

By L. O. Marden

Worcester County Engineer, Worcester, Massachusetts

BEFORE making the preliminary survey for a new highway, consider the relative importance of highway in the present and future county road system: will it become part of a through route, or may some industry locate along it? Then select the termini. Count the existing volume of traffic and study traffic conditions in other counties and states on the similar type of highway, and prepare curves forecasting future density of traffic. From this the type of highway, the number of lanes of pavement, the directness of the route, the flatness of the curves, elimination of grade crossings, or important highway underpasses or overhead bridges and the correct width of layout can be determined.

This analysis should also consider the financial ability of the county to raise money by a bond issue, or construct the highway from current funds. Recommendations can then be made as to the probable amount of money available per mile for the construction of the highway.

Preliminary Survey

If the construction is to be in a rough and mountainous country, time and money may be saved by an airplane survey. An accurate location of the highway often can be made from these photographic maps. If money is not available for this method of reconnaissance, the topographic sheets of the United States Coast and Geodetic Survey can be used. In the absence of these, a stadia survey should be made of the strip of country in question, showing elevations (from which contours may be computed and interpolated), all drainage features, railroads, highways, houses, villages, and any other important features. A contour map incorporating all of this information can be drawn from this survey. A proposed location for the highway can then be located upon this map.

The location engineer should then proceed to make the preliminary survey as closely as possible to this proposed location.

The United States Bureau of Public Roads in 1924 listed 13 dangers to be removed from existing highways when a relocation is being considered, as follows: Blind curves and road intersections, sharp curves on embankments, unprotected embankments, narrow bridges, sharp curves, vertical curves, slippery road surfaces, steep crowns, sharp curves at bridge and underpass approaches, grade crossings and unsuperelevated curves.

Accuracy of Base Line Survey

In Worcester County, Massachusetts, due to land values, all base lines are run to hundredths of a foot, and all angles are turned four times. Curves are also "run in" as part of the base line. Where possible, these lines are tied in with the Massachusetts Control Survey. An independent back traverse is made, which is tied in with the base line angles.

Permanent ties are set for all base line angle points of curvature, and at the beginning and end of the base line. Where possible, these ties consist of drill holes in ledge, or building foundations, etc. These drill holes are filled with lead wool rammed in place, and a bronze escutcheon pin is driven into the lead. Temperature corrections are made of base line measurements. Level lines are, if possible, tied in with the United States Coast and Geodetic Survey bench marks. Bench marks are set about five hundred feet apart along the base line, due to the rugged contours of the county. The beginning of a base line is usually tied in accurately with the town line, so that true bearings can be used on the completed layout. The use of true bearings is, of course, extremely valuable to the land surveyor as it enables him to use true bearings on all property surveys abutting the county highway layouts. In more sparsely settled parts of the United States, a low-cost road can be constructed from surveys made to tenths of a foot.

In Worcester County a transit party consists of chief, transitman, and chainman. When survey conditions are difficult, a fourth man is added to the party. A level party consists of three men, chief of party, levelman and rodman.

Alignment

For important roads the most direct line giving the least gradient between the termini should be used; but if funds are limited, follow the contours as closely as possible, using minimum radius of curvature of 600 feet.

Where snowfall is heavy, learn the prevailing winds of the region and select a route which will secure a drift-free road, following, if possible, a ridge in open country. In prairie regions, the new grade should be raised a sufficient distance above the surrounding terrain to prevent drifting. Deep, long cuts should be eliminated as much as possible.

Grades

The maximum grade on a farm-to-market highway may be as much as ten per cent, if each end of the grade is connected with easement grades. Curves on grades of this percentage should be compensated to permit a constant ascending speed. Sharp curves at the end of a long grade should be eliminated from the design. The maximum grade on a secondary highway should not be over eight per cent, except perhaps in mountainous country. The maximum grade on main routes should not be over seven per cent.

It is essential to provide a long sight distance over a vertical curve for high-speed traffic. A minimum sight distance of 400 feet should be used on farm-to-market highways. On secondary routes, it is good engineering practice to use a vertical curve giving a minimum sight distance of 600 feet. On mountain type locations "sight shelves" cut into the inside of curves of cuts or highway banks, will provide longer sight distance.

Horizontal Curves

In Worcester County the minimum radius of curvature preferred on horizontal curves is 500 feet. However, where it is impossible to obtain better than a 300-foot radius, a study of alignment, grades, and the use of white lines, and proper warning signs will provide a safe road. A radius of under 600 feet is an exception on our secondary roads, and every effort is made to obtain a radius of not less than 1,000 feet.

All horizontal curves should be superelevated according to standard engineering practice. In selecting a

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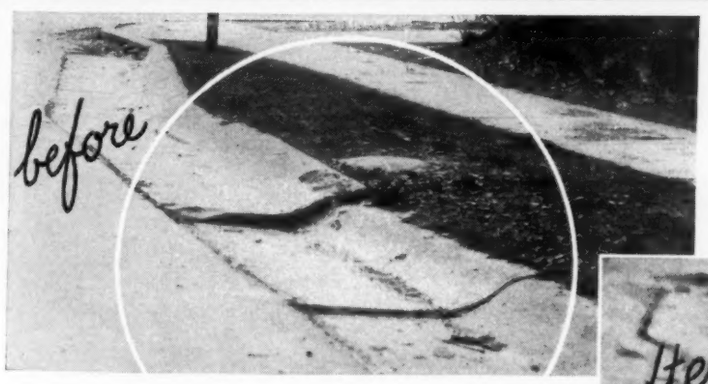

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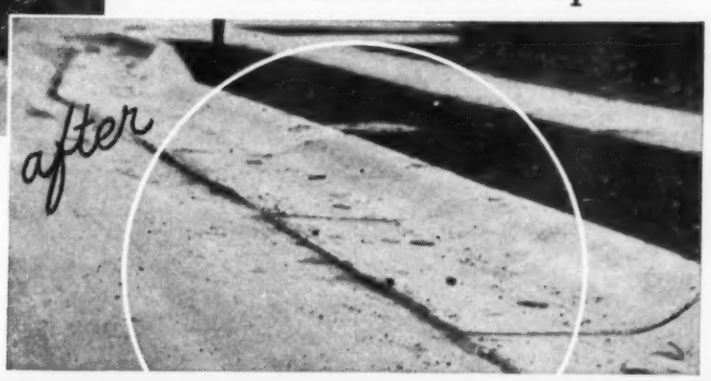

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maximum superelevation for a horizontal curve in northern areas, where ice sometimes covers pavement, it should be remembered that too steep a slope will sometimes cause a vehicle to slide off the pavement.

The pavement should be widened on the inside of all horizontal curves up to and including a radius of 1,000 feet. Widening should vary from three feet for a curve of 500 feet radius to one foot for a curve of 1,000 feet radius. Widening and superelevation of curves should begin at a point at least 200 feet back on the tangent from each end of the curve.

Reverse, compound, or sharp curves should not be used at bridge and underpass approaches, grade crossings, or any type of highway. Reverse curves should preferably be separated by a tangent at least 300 feet in length.

Widths of Right of Way

The average widths of right of way should be:

Farm-to-market road—minimum width 60 feet.

Secondary road—minimum width 60 feet, maximum width 100 feet.

Main traveled route—minimum width 80 feet, maximum width 150 feet.

Scenic highway—minimum width 80 feet.

The modern highway needs ample room for snow removal, public utilities, wide ditches, flat slopes, sight shelves. Light and telephone poles should be set at least five feet from the outside of the shoulder. The right of way should be of such width that the number of lanes of pavement can be increased at some future time, without taking additional land. Land taken for a second widening of a highway layout is usually held at a higher valuation than when the first layout was made.

Rights of ways in Worcester County are bounded at all points of curvature, at all angle points and at the termini of the layout, by Worcester County highway bounds six inches square by six feet six inches long, constructed of reinforced concrete.

Although stop signs and lights are generally provided at many important intersecting roads, and railroad crossings on the modern highway, it has been found that the number of accidents at these dangerous intersections has diminished appreciably by providing sufficient sight distance to enable the driver stopping at an intersection to see approaching cars or trains. Assuming a speed of forty miles per hour, which gives a speed of about 60 feet per second, the average driver can stop a motor vehicle in about 180 feet. Land should be taken if possible at intersections of this type in order that a sight can be had for a distance of 200 feet each side of the center of the crossing. In Worcester County, this type of taking has been made at practically all dangerous approaches.

The above is abstracted from a paper before the 1936 ARBA meeting.

Removing Bituminous Surfacing With Burners

In resurfacing a portion of the Sunset Highway near Los Angeles, Calif. (described in "California Highways and Public Works" by J. M. Lackey, assistant district construction engineer), the plans provided for the removal of portions of the old surfacing to permit laying a 1½ inch asphaltic concrete wearing surface. Removal of the irregular thickness of the old asphalt surface was no easy problem, as under years of traffic the asphalt had become hard and tough. The special provisions of the contract provided that where an excessive quantity was removed the contractor should replace it at his own expense. An added complication was that a variable height crown was used, often changing several times in the distance of a block.

The old surface was removed by burning. At the beginning of the work two pavement burners were obtained from the city of Los Angeles, each unit being mounted on a truck. A single distillate burner covered with a 6x9 foot hood was suspended from cantilever arms from the rear of the chassis. A separate gasoline motor on the chassis operated air pumps attached to the burners.

To speed up the work the contractor constructed two much larger outfits. Each unit consisted of six burners operated under a 9x15 foot hood mounted on wheels and towed by a road roller, both burners being operated together. A small compressor furnished air to both units. The procedure was as follows:

Grade points were set at from 10 to 20-ft. intervals in the old surfacing and the amount of the cut painted near the point. The burners were then set to work, remaining stationary for from 3 to 5 minutes, depending on the thickness of the surfacing to be removed, then moving about 3 feet.

This operation was followed up with a tractor and grader which windrowed material loosened by the burning for loading into trucks. The surface was then checked, high spots marked and burned with the units obtained from Los Angeles City.

From 550 to 900 square yards of surfacing were covered by the two large burners per 10-hour day. The area covered depended on the thickness of the old surface to be removed. Kerosene required for 10 hours of burning totaled 400 gallons, which, at a cost of 5 cents per gallon, amounted to from $0.025 to $0.036 per square yard for fuel.

On account of street cars, the burners could not operate within several feet of the rails, and a strip 17 feet wide was burned by direct application of distillate to the surface. In this manner, 200 to 300 square yards were burned per day, using about 300 gallons of distillate at a cost of 3½ cents per gallon, a total of $10.50, or $0.035 to $0.0525 per square yard.

The section paved was all outside the street car tracks and consisted of 27 feet of asphaltic concrete surfacing and a 2-foot cement concrete gutter on each side of the street. A 20-foot section out from the gutter was spread and finished with a finishing machine and the remaining 7-foot spread and raked by hand.

On the hand-raked section a concrete float was used after the hand raking in much the same manner as used on concrete pavement, with excellent results.

One feature of the job was the use of a mortar-supported side form for support of the spreading machine on the side opposite the gutter. The forms which were only 1½ inches by 6 inches laid flatwise, were secured by driving a large spike through the plank into a wooden plug which had been wedged into a 2-inch hole drilled into the old concrete pavement. The side form was then shimmed up to grade and the space underneath filled with a 1 to 5 cement mortar.

These side forms took a terrific pounding from traffic with very little damage and the maintenance cost was small. In a few places the mortar became reduced to a powder, probably due to using too dry a mix which dried out too soon.

Traffic on this street is very heavy at all times. Traffic counts taken on January, April and July, 1934, showed that Sunday traffic amounted to 15,000 to 19,000 cars per day and week day traffic from 20,000 to 23,000 cars daily. Street railway traffic is also heavy, carrying both interurban and local cars.

Cost of Laying Water Pipe with Relief Labor

Data furnished by a number of cities, covering costs on various types and sizes of piping

THE cost data given below have been furnished us by a number of water works superintendents throughout the country. All are believed to represent 1935 work and all were reported to us subsequent to October 1. Considerable variations appear in these figures, most of which are readily explainable. It costs, for instance, much more to lay a pipe in a paved street carrying considerable traffic than it does in an unpaved residential street. Weather conditions and subsoil formations are also important. Material not classifiable as "rock" may cost just as much to remove with the inadequate equipment usually provided to relief labor.

Bearing these factors in mind, the figures given can be used quite readily in estimating costs of laying water mains by relief labor. Where possible, additional data on each project are given briefly in the tables. In all cases, it is believed, except where otherwise noted, the figures cover excavation, furnishing and laying the pipe, making the necessary connections, furnishing and placing valves and hydrants, and backfill.

Other Data

H. A. Sheldon, commissioner of water, Port Jervis, N. Y., states that it costs about one-third more to do construction work using relief labor than with selected men.

G. F. Walton, superintendent of the Water Department, Glassboro, N. J., who reported laying a line of 8-inch McWane precalked pipe, states: "During the last of October and the first part of November, 1935, we secured a grant from the government for labor on a project to connect the water systems of our borough and our immediate neighbor on the north (Pitman), our water department to furnish all material and skilled mechanics. The total cost of this small job was high ($4 per foot) because of the number of 8-inch valves (3) and stub mains from a paved main highway (2), and the building of valve vaults. The line was 400 feet long. Added to the cost was the breaking of a concrete road, since our county engineer would not permit tunneling under it, and its replacement by hand labor.

Other Types of Pipe

Pipes of materials other than cast iron were reported to us as follows: Colton, Calif., 5,000 feet of 6-inch steel pipe cost 55 cents per foot; Red Bluff, Calif., 7,500 feet of 12-inch steel pipe cost $1.60 per foot; Framingham, Mass., 2,500 feet of 6-inch Transite pipe cost $2.43 per foot; Westborough, Mass., 1,000 feet of 6-inch Transite pipe cost $2.50 per foot; New Ulm, Minn., 2,700 feet of Transite pipe cost 75 cents per foot; Enid, Okla., 1,800 feet of Transite pipe cost 75 cents per foot; Logan, Utah, 8,000 feet of 24-inch steel pipe cost $6.50 per foot; Ogden, Utah, 1,600 feet of 16-inch steel pipe cost $6.60 per foot, including rock excavation; Aberdeen, Wash., 4 miles of 28-inch wood stave pipe cost $12,000 per mile.

The above figures are believed to include all costs in connection with the work.

Cost of Laying 6-inch Cast Iron Pipe

	Length	*Cost per ft.*
ARIZONA:		
Douglas	6,000	$1.10
Tucson	2,700	2.43
CALIFORNIA:		
Pasadena	14,326	.95
Pittsburg	2,000	1.80
COLORADO:		
Greeley	5,000	.80
CONNECTICUT:		
Manchester	898	4.92*a*
Southington	511	1.95*b*
ILLINOIS:		
Bloomington	600	1.28
Galesburg	1,834	1.28
Galva	620	1.22
INDIANA:		
Decatur	3,000	.90
Columbia City	1,400	1.04
Michigan City	1,500	1.35
Tell City	3,408	.90
Goshen	6,000	1.06
IOWA:		
Carroll	2,329	1.60
Cedar Rapids	3,242	1.42
Marshalltown	5,000	1.29
Muscatine	500	1.08
KANSAS:		
Abilene	2,500	1.50
LOUISIANA:		
Morgan City	3,000	1.00
MARYLAND:		
Cumberland	555	1.52
Cambridge	1,000	1.00
MASSACHUSETTS:		
Framingham	1,000	2.90
Holbrook	3,500	3.50
Milton	1,500	2.45
Northampton	3,800	1.75
North Andover	450	2.90
Rockland	4,000	3.00
MICHIGAN:		
Sault Ste. Marie	3,000	3.00
MINNESOTA:		
St. Paul	920	2.85*c*
Stillwater	10,000	2.00*d*
Winona	377	1.96
MONTANA:		
Lewiston	1,500	1.60
NEBRASKA:		
Columbus	5,280	.83
NEVADA:		
Reno	5,000	1.50
NEW HAMPSHIRE:		
Berlin	1,000	1.25
Franklin	3,000	1.52
NEW YORK:		
Elmira	1,080	2.00
Hoosick Falls	5,400	.79
Johnson City	11,000	1.43
Ossining	1,000	2.00
Salamanca	1,400	1.28
OHIO:		
Akron	15,840	2.65
Girard	13,660	2.50
Lima	1,200	1.00
Middletown	2,800	1.64
Niles	1,800	1.18*e*
Port Clinton	20,700	2.00*f*
Cincinnati	9,446	.75
Wadsworth	4,400	1.33
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Altoona	1,200	3.00
Ashland	3,500	2.10

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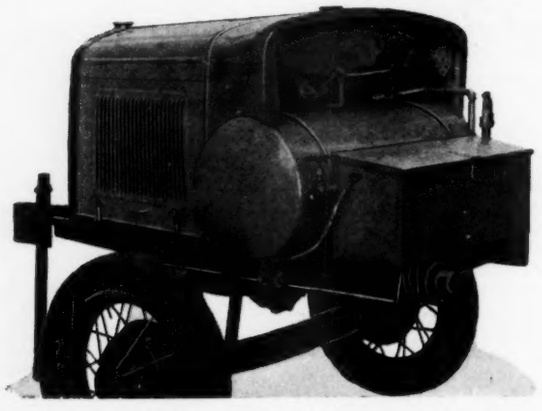

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Aberdeen	3,562	2.03*g*
Rapid City	3,500	.88
TENNESSEE:		
Knoxville	4,448	2.39
Murfreesboro	400	1.20
TEXAS:		
San Antonio	11,874	1.47
VERMONT:		
Rutland	3,000	1.50
VIRGINIA:		
So. Boston	3,600	1.40
WASHINGTON:		
Auburn	6,427	.63*e*
Spokane	4,534	1.68
WISCONSIN:		
Appleton	4,089	1.31
Baraboo	2,500	.90
New London	2,000	1.10
Racine	3,600	2.93

Cost of Laying 8-Inch Cast Iron Pipe

	Length	*Cost per ft.*
Huntington Park, Calif.	5,000	1.40
Lodi, Calif.	500	1.85
Pasadena, Calif.	2,089	1.49
Greeley, Colo.	3,000	1.25
Hartford, Conn.	2,294	1.67
Southington, Conn.	3,331	2.50*b*
Carroll, Iowa	816	2.70
Goshen, Ind.	4,500	1.40
Cumberland, Md.	1,868	2.27
Milton, Mass.	7,000	2.81
Webster, Mass.	2,935	1.05
St. Paul, Minn.	7,390	3.50*h*
Reno, Nev.	500	1.80
Berlin, N. H.	2,000	1.40
Madison, N. J.	5,900	1.20
Elmira, N. Y.	320	1.90
Johnson City, N. Y.	4,000	1.43
Salamanca, N. Y.	3,100	2.38
Akron, O.	7,920	3.15
Girard, O.	1,200	2.75
Niles, O.	3,100	1.21*e*
Middletown, O.	2,350	2.06
Wadsworth, O.	3,400	1.90
Hamburg, Pa.	5,432	2.50*i*
Dallas, Tex.	8,277	2.99
San Antonio, Tex.	1,762	2.04
Auburn, Wash.	1,099	.96*e*
Appleton, Wis.	1,212	1.62
Stoughton, Wis.	1,000	1.50

10-inch Cast Iron Pipe

	Length	*Cost per ft.*
Tucson, Ariz.	2,600	4.07
Hartford, Conn.	4,727	1.90
Bloomington, Ill.	....	2.46
Augusta, Me.	1,063	3.00
Northampton, Mass.	617	3.00
Reno, Nev.	600	4.50*j*
Wadsworth, O.	700	2.80
Knoxville, Tenn.	2,041	3.07
Appleton, Wis.	542	3.43

12-Inch Cast Iron Pipe

	Length	*Cost per ft.*
Tucson, Ariz.	1,300	4.45
Pasadena, Calif.	5,406	2.28
Hartford, Conn.	4,727	3.10*k*
Goshen, Ind.	1,500	2.27
Baltimore, Md.	1,400	5.00
Milton, Mass.	1,300	4.41
Sault Ste. Marie, Mich.	2,700	5.00
Northampton, Mass.	1,895	4.00
Berlin, N. H.	1,500	3.50*m*
Johnson City, N. Y.	4,100	2.96
Akron, O.	5,280	4.75
Altoona, Pa.	6,200	4.65
Nashville, Tenn.	47,600	3.32
Dallas, Tex.	1,446	3.13
So. Boston, Va.	3,800	2.51
Wyandotte, Mich.	1,900	3.48
Buffalo, N. Y.	8,285	9.54
Hamburg, Pa.	2,700	3.50*i*
Spokane, Wash.	1,212	5.65

16-Inch Cast Iron Pipe

Goshen, Ind.	1,000	3.22
Cumberland, Md.	2,337	3.53
Jackson, Miss.	1,800	1.90*e*
Nashville, Tenn.	5,825	5.04
Dallas, Tex.	3,482	6.70

18-Inch Cast Iron Pipe

	Length	*Cost per ft.*
Dallas, Tex.	1,625	6.32

20-Inch Cast Iron Pipe

	Length	*Cost per ft.*
Greenfield, Mass.	7,200	4.86
Johnson City, N. Y.	3,000	5.64
Dallas, Tex.	4,037	7.34

a—includes grading costs; *b*—includes cost of gates but not of hydrants; *c*—labor amounted to $1.83 per foot; *d*—in rock, the costs were higher; *e*—labor cost only; *f*—labor cost was $1 per foot; *g*—average price for 6" and 8," including hydrants and fittings; *h*—labor cost was $2.45; *i*—cost does not include valves and hydrants; *j*—work was in paved streets; *k*—work was done under winter conditions; *m*—this was in rock excavation.

Soil Freezing and Frost Heaving

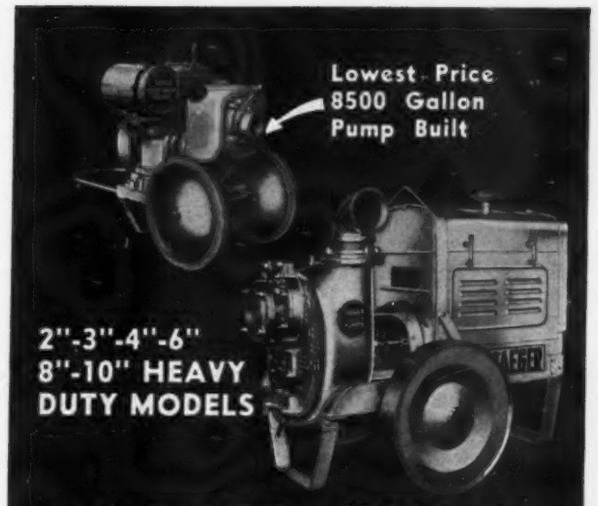
The following synopsis of a report by G. Beskow, Stockholm, appeared in "Road Abstracts." The report contains 242 pages, 87 illustrations and 28 tables. The quoted price is 4 kronen (slightly over $1).

The report deals with the presence, movement and crystallization of excess water in the soil; phenomena due to the melting of ice thus formed, are not considered. The work of Jung, Taber and Kokkonen is summarized. The author differs from Kokkonen's view that the amount of frost-heaving depends on the proportion of water originally present in the soil; Beskow's work indicates that when the proportion of water does not exceed the saturation limit for the soil concerned, and when no further access of water is possible, all soils freeze homogeneously. Ice deposits may form in a fine soil when water in excess of the saturation content is present or available. In coarse soils, freezing is almost always homogeneous. Taber's work on the influence of pressure has been continued.

An expression is given for the depression in freezing point to be expected in the case of homogeneous soil fractions of given particle size. The distribution of the ice in the frozen soil is influenced by particle size, rate of freezing, pressure and water supply. The adsorption film surrounding large particles is relatively thin, and the movement of water to the points of contact between the soil particle and the ice crystals is hence slow. Pressure decreases the thickness of adsorption films, and thus checks the transfer of water to the centres of freezing. Water must be present in the soil in excess of saturation, either at the beginning of freezing or by subsequent capillary transfer from the groundwater supply.

Under the conditions prevalent in Sweden, most soils liable to frost-heaving are at least saturated with water, which is likely to be in considerable excess in the clay and loam strata, at the beginning of winter. Deposits of ice are usually associated with a mean particle size of about 0.06 mm., whilst if the water-supply is very plentiful the mean particle size may be 0.1 mm. Under most conditions this range of sizes constitutes the limiting range between soils susceptible to frost-heaving and those which are immune; but heaving may be produced in coarse soils without any appreciable degree of ice deposition if the rate of freezing is sufficiently rapid.

Freezing experiments on artificial soil-water systems, with and without excess to an additional water supply, show that in coarse soils heaving occurs in a



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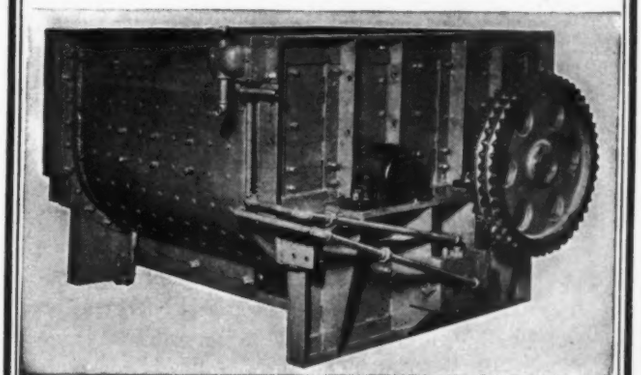

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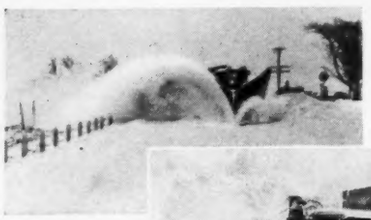

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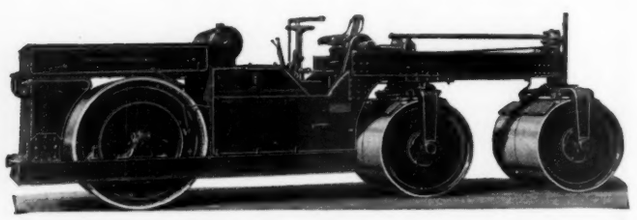

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closed but not in an open system; water is forced downwards in the latter case. In fine soils, a slight expansion is always caused by the dilatation on freezing of the water present in the soil, but unless additional water can enter the system the expansion is negligible in its application to practical road conditions. Where soils are only partially saturated, the water either expands into the voids or causes heaving by forming lenticular ice-crystals between the particles; this type of heaving can be almost entirely prevented by an increase of pressure. All frost-heaving of practical importance depends on the supply of additional water to the frost zone.

The apparatus used for investigating the influence of various freezing conditions consisted of a column built of glass rings 1.3 in. in diameter and 0.4 in. deep; the friction of the soil against the walls was reduced by lubrication; the rings were lifted in succession as the freezing zone moved downwards through the sample. The only operative pressures were thus the applied load pressure and the capillary pressure, both of which were capable of exact regulation.

It was found that the rate of frost-heaving was independent of the rate of freezing. Hence, gradual freezing causes a great excess of water to accumulate in the form of ice deposits, in the frozen soil; rapid freezing results in the formation of thin scattered layers of ice. The rate of frost-heaving depends principally on particle size, ion concentration in the soil water, and pressure. The influence of the ground-water level has also been investigated by the author, who concludes that in highly capillary soils the rate of frost-heaving is (roughly) inversely proportional to the ground-water depth.

Since the thickness of adsorption films, and hence the mobility of their constituent particles, is influenced by the presence of dissolved substances, it is to be expected that the addition of soluble materials should influence the frost-heaving process: the substances studied were sodium chloride, calcium chloride, sulphuric acid and sulphite lye. Sodium chloride was found to increase heaving in dilute, and to prevent it in stronger solutions; the other materials caused a progressive decrease with increasing concentration. Sulphite lye, which is readily and cheaply obtainable in Sweden, may prove to have a considerable, practical value in road treatment; recent work shows that this material is so effectively adsorbed that its influence is likely to be durable especially under impermeable surfacings. Instances of frost-heaving are illustrated, and the actual values of capillarity and permeability in ordinary soils are discussed with special reference to the influence of fissures and of stratification.

The concluding section deals with the influence of ground temperature conditions, notably the local mean temperature gradient and the effect of protecting layers of snow.

Control of European Elm Scale

The best treatment for European Elm scale, according to a recent report by C. R. Cleveland, entomologist of the Standard Oil Co. of Indiana, is a clean, highly-refined mineral oil, treated to emulsify completely with water in all proportions. It is mixed with water in concentrations ranging from 4 to 6 or 7 per cent, depending on the scale insect to be controlled, and sprayed on the infested trees. Properly and thoroughly applied, the spray oil registers a kill of adults, young, or eggs of practically 100 per cent. The same oil used at varying concentrations is equally effective in controlling the scale enemies of other species of trees.

Seven Miles of Highway Graded, Surfaced and Opened in 42 Days

IN late August, 1935, California State Highway 64, through Box Canyon, was entirely destroyed for a length of 7 miles by high water. Repair work began that day, using available equipment, which was supplemented a few days later by additional equipment from other parts of the state.

As the road lies almost entirely in the bottom of the wash, only tracklaying type equipment could be used, the sand being too unstable to afford traction to wheeled equipment. The entire seven miles of road was graded with tractors operating bulldozers, revolving scrapers and road graders.

Field location surveys were made immediately in advance of the grading forces, grades laid in the field and stakes set for construction. The road by this method was built on much better alignment than the old road which followed the pioneer wagon road closely, traversing lines of least resistance. Advantage was taken of the experience gained during many years of maintenance and the road located where it will be least affected by future floods.

On September 20th, when grading operations had advanced sufficiently to allow of unimpeded progress to oiling operations, surfacing was started. The surface was constructed to a width of 20 feet by mixing the natural sandy material with asphaltic oil at the rate of two gallons per square yard.

Grading and surfacing had advanced sufficiently on October 7th, to permit of opening the entire seven miles of road to light traffic, 42 days after the flood.

The road was compacted sufficiently to permit of its opening to unrestricted traffic on October 17th and final trimming was done and the job completed on October 25th.

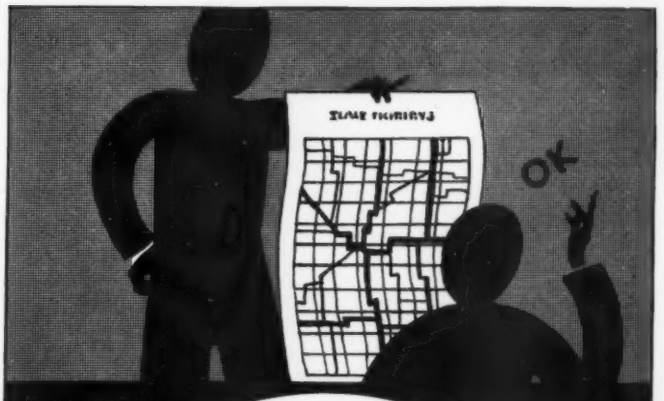
Five hundred tons of asphaltic oil were used in constructing the surface and the total cost of the seven miles of road, including grading, was $12,000. All work on the project was done by the maintenance forces of the California Division of Highways, under the direction of Superintendent Mitchell at Indio.

County Reports on Stabilization

Stabilization of gravel roads by the addition of binder soil and calcium chloride not only greatly decreases maintenance operations but also provides excellent base for higher type surfacing, according to the annual report of the Washtenaw, Michigan, Board of County Road Commissioners for 1935.

The report specifically cites the experience with one section of a clay-calcium treated road which went for a period of eight weeks during the summer without requiring grading or any maintenance whatever, even though there were frequent rains. The report also points out that most failures in flexible pavements are due to inadequate base, and that stabilization provides an excellent and economical base on which to lay this type of surface.

"The problem of how to provide adequate yet economical maintenance for gravel surface roads has been with us for many years" the report states. "Motor traffic is increasing both in speed and volume, and the rapid wearing out and disintegration of gravel roads is cause for concern. Our organization has clay-stabilized several miles of main traveled gravel road. Upon completion, the road surface is smooth, hard, free of dust, and does not rut up."



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An Outline of WPA Work in New York State

By Arthur H. Myers
Assistant Administrator Works Progress Administration of New York State

THE most outstanding WPA project at the present time, in my judgment, is the work in the Palisades Interstate Park in Orange and Rockland Counties. The project employes 3400 men from the counties of Westchester, Orange and Rockland and the cities of Yonkers, Mount Vernon, New Rochelle, White Plains and Newburgh. Special trains and buses, paid by the federal government, transport the workers to and from work.

This project, sponsored by the Commissioners of the Palisades Interstate Park, a state agency, was started in November, 1932 by the New York State Temporary Emergency Relief Administration and has been continued since then without interruption.

About $7,000,000, mostly wages, has been spent to date on the project and WPA contemplates the expenditure of approximately $4,000,000 additional.

The Palisades Park Work

The Palisades Park comprises 47,200 acres of land, extending from Fort Lee, New Jersey north to West Point. The widest point, from Bear Mountain to Arden, is approximately 20 miles. There are numerous lakes, both natural and artificial, large and small. Several hundred organizations, charitable and social, have camps throughout the Park.

All surveys, estimates, details and planning are made by the Park Commission under the direction of Major William A. Welch, General Manager and Chief Engineer. The construction is under the supervision of John J. Tamsen, General Superintendent of Construction. Both of these men have been with the Commission for more than twenty years.

The work itself consists of buildings, sewers, water supply, roads, trails, firelanes, creation of new lakes and forestry.

All main roads in the park have been or are being widened to accomodate three lanes of traffic. Dangerous curves are being eliminated and guard rail and parapet stone are being placed where needed. The new roads, as well as the old, are built with a hand-placed telford base, varying in depth from 9″ to 18″, plus gravel and stone, with a black top surface.

Sewer and Water Construction

Sewer lines are being constructed to accommodate the camps on the various lakes. For this purpose, concrete pipe, cast in the field as part of the project, is being utilized.

Water lines are being laid from all water supplies to the various camps and picnic areas. All water is chlorinated, filtered and aerated.

Bridle paths, winding throughout the park, built with a telford base and dirt surface, are also being constructed.

Two dams, for the creation of new lakes and water supply, are in the course of construction. These dams are all earth, with core wall construction, rip-rapped with heavy stone.

The buildings, all of native field stone, are for administrative purposes and for recreational facilities.

In Buffalo, on the site of the old Best Street reservoir, a stadium and park development is under way. The plans call for a stadium, base ball and foot ball fields, swimming pool, wading pool and marine airport.

Other Work in the State

In Syracuse, the Ley Creek sewage disposal plant will be constructed by WPA.

The Village of Pittsford, in Monroe County, will build a sewage disposal plant through PWA and the sewers and interceptors by WPA.

There are hundreds of smaller projects for sewer and water line construction, roads, sidewalks, curbs and gutters which are useful improvements but not large enough to mention.

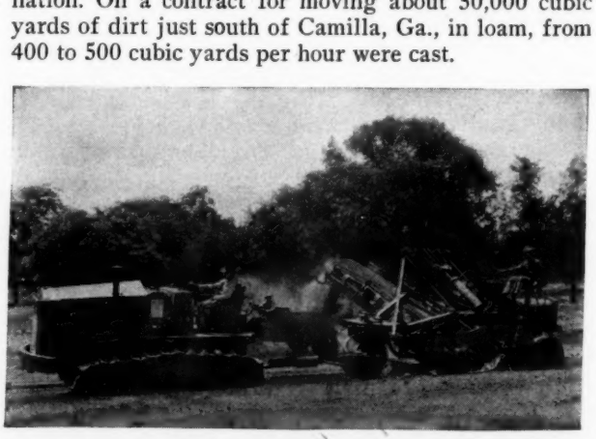
It is too early to have reliable cost data. Projects will have to proceed a bit further before information of this kind will be available and of any use. Unit costs will naturally decrease as the labor, some idle for years, becomes more accustomed to work and greater efficiency results.

For a rough guess, I should say labor is approximately 70% of the project. Sponsors' contributions are in the neighborhood of 25% of the total cost of the jobs.

Loading 120 Trucks an Hour

The accompanying illustration shows a Cletrac "80" diesel and an Austin-Western 48-inch elevating grader at work in Georgia. This outfit, owned by Irvin Baker, contractor, Pine Park, Ga., was started on grading and widening the streets of Newton, Ga. On this work, the outfit handled about 200 cubic yards an hour, despite the shallow cut and frequent turns, using 2-yard dump trucks for handling the spoil.

On a borrow job, where 18 inches of dirt was removed from a field intended to be used for a baseball diamond, 120 truck loads an hour were delivered by the combination. On a contract for moving about 50,000 cubic yards of dirt just south of Camilla, Ga., in loam, from 400 to 500 cubic yards per hour were cast.



Moving dirt at a paying rate in Georgia. A Cletrac "80" and an Austin-Western 48-inch elevating grader handle up to 500 yards per hour.

A.S.C.E. – N.Y.S.S.W.A. – A.R.B.A. Meet

Conventions of the above, which are enginering and technical societies, and not alphabetical agencies lining up for their turn at the Supreme Court, met during January. The American Society of Civil Engineers held its annual meeting in New York City; coincident with it, and with some of the sessions held jointly, the New York State Sewage Works Association also met; the following week the American Road Builders' Association met in Cleveland in conjunction with the Road Show.

American Society of Civil Engineers

The meetings of this society were held January 15-18, and as usual covered a wide range of topics. The first day was largely given over to business; on the second day there were sessions of the city planning, structural, highway and sanitary engineering divisions, with a smoker in the evening. Friday and Saturday were given over largely to inspection trips.

Honorary memberships were conferred on John W. Alvord, consulting engineer of Chicago; J. F. Coleman, consulting engineer of New Orleans, La.; Mortimer E. Cooley, dean emeritus of the colleges of engineering and architecture of the University of Michigan and State PWA engineer; and W. J. Wilgus, consulting engineer of Ascutney, Vt., and previously head of the WPA in New York City.

Medals and prizes were awarded as follows: To the late D. C. Henny, the Norman Medal for his paper on the "Stability of Straight Concrete Gravity Dams." To A. T. Larned and W. S. Merrill, the James R. Croes Medal for their paper "The Actual Deflections and Temperatures in a Trial-Load Arch Dam." To W. H. Kirkbride, the Thomas Fitch Rowland prize for his paper "The Martinez-Benicia Bridge." To Wilson T. Ballard, the James Laurie prize for his paper "Three-Span Continuous Truss Railroad Bridge, Cincinnati." The Arthur Wellington prize to Hawley S. Simpson for his paper "Use and Capacity of City Streets." To C. Maxwell Stanley, the Collingwood prize for juniors for his paper "Study of Stilling Basin Design." The Rudolph Hering Medal to John H. Gregory, the late Robert Simpson, Orris Bonney and Robert A. Allton for their paper "Intercepting Sewers and Storm Stand-by Tanks at Columbus."

Daniel W. Mead was elected president, succeeding Arthur S. Tuttle.

New York State Sewage Works Association

The eighth annual meeting of this association really began with the Sanitary Engineering dinner held jointly with the Sanitary Engineering Division of the ASCE. At the technical sessions following there were papers by Earl Devendorf, Dr. C. R. Roberts, Harry Hendon, Samuel I. Zack, A. J. Fischer and John V. Fenton. The visit to the Great Neck sewage treatment plant on Friday was arranged through the courtesy of the Municipal Sanitary Service Corp.

The Kenneth Allen memorial awards were made to Samuel I. Zack for the most meritorious paper of a technical and research nature, and to Harry Hendon for the best paper on sewage plant operation.

Fred J. Biele of Huntingdon, Harry Eustance of Ithaca, and T. J. Smith of Newark, N. Y., were elected to the executive committee for the next three years. L. H. Enslow was elected president and C. C. Agar of Albany, vice-president of the association. A. S. Bedell was reappointed secretary-treasurer.

American Road Builders' Association

As usual, the technical sessions of the ARBA, which was held at Cleveland, O., Jan. 20-24, were overshadowed by the Road Show. At the Road Show was the greatest assortment of equipment that has been exhibited for several years; in fact, it is likely that the 1936 Road Show brought out the finest collection of modern and efficient highway construction equipment that has ever been seen. There were some 230 exhibitors, with exhibits spread over an area of 2½ acres.

The Road Show was needed to demonstrate to the industry the modern equipment available for the construction, efficiently and at low cost, of modern types of highway surfaces. Visual impressions of such equipment undoubtedly produced an effect that will be felt throughout the industry, and emphasized the necessity for the use of up-to-date machinery.

At the technical meetings, excellent papers on various phases of the advance in knowledge of highway construction methods were presented. These numbered more than 70 and covered nearly all phases of the field. One or two of these will be found abstracted on other pages of this issue, and others will be presented from time to time.

Wood Handbook

Forest Products Laboratory, Forest Research, Madison, Wis., 1935, 325 pp. $0.25.

This handbook devotes special attention to timber fastenings, including the latest data from tests of nails, screws, bolts, spikes and plate and ring connectors. Modern fields of use are covered in the sections on glued wood construction, plywood, bent members, laminated units, solid and built-up beams, columns and arches.

A practical problem that has caused much trouble to designers and estimators is simplified in the treatment of grades and sizes of lumber and structural timbers, to the end that commercial grading rules may be read intelligently and specifications written to obtain required hardwood or softwood material that the trade can supply. Another section contains information on the moisture content of wood and its control.

The structure, composition and physical properties of wood are treated fully.

Those who desire information on wood as a material and how to use it to secure the best results, will find this handbook will answer their principal questions.

Training for the Public Service:

A Report and Recommendations. Edited by Morris B. Lambie for the Public Administration Clearing House. Publication No. 49, Public Administration Service, Chicago, 1935. xiv + 49pp. Fifty cents.

This pamphlet summarizes the discussions, resolutions, and recommendations of a three-day Conference held at Princeton, N. J., in June, 1935.

Personal Items

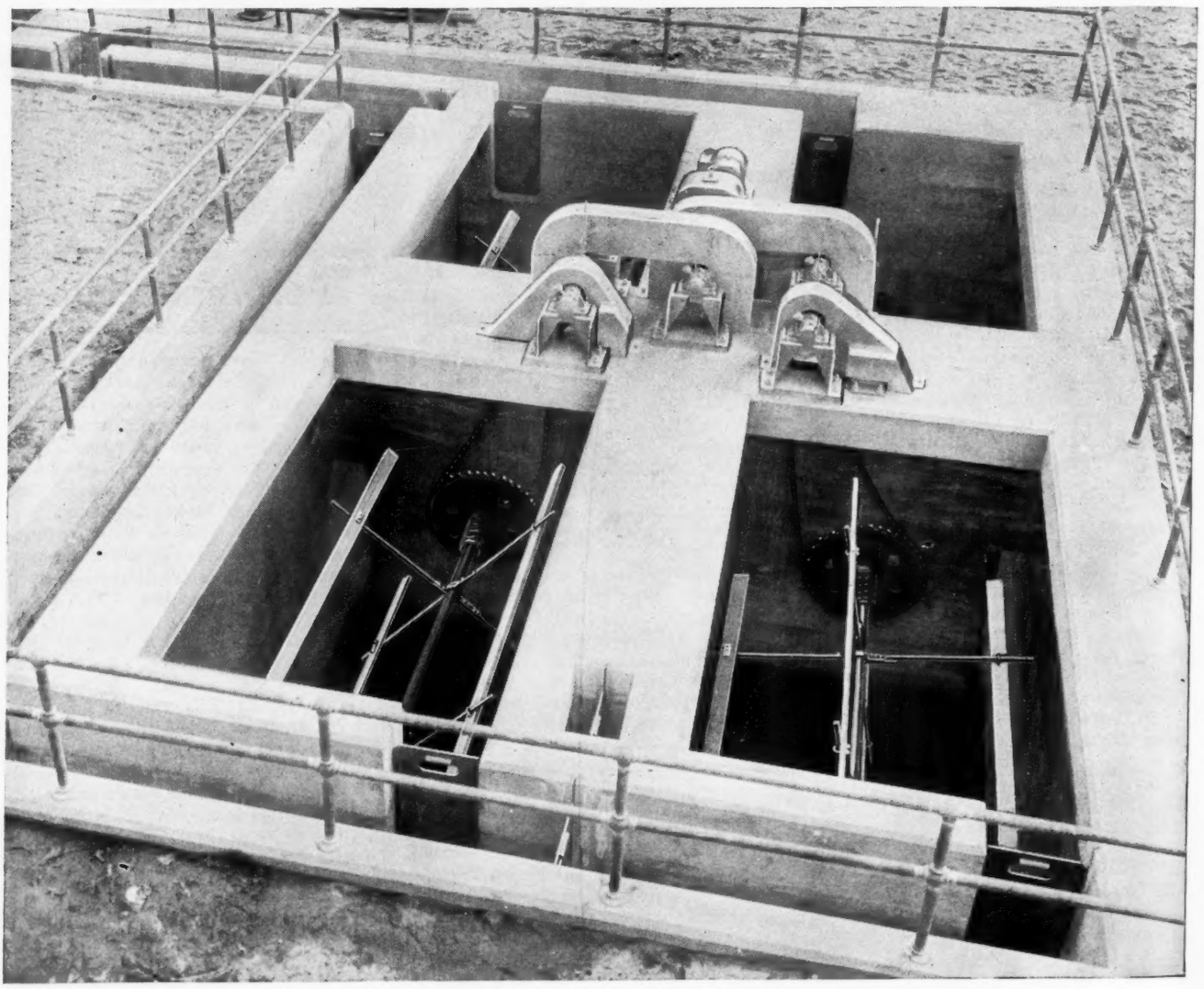
Mark B. Owen, for many years Superintendent of the Department of Public Works and Engineering of Dearborn, Mich., and who has done so much to make that city a mecca for sewerage engineers all over the world, has resigned that position and become associated with the Nichols Engineering & Research Corporation, of New York City, as vice-president and director. This is the company that built the Nichols-Herreshoff incinerator for disposing of Dearborn's sewage sludge.

John N. Edy, assistant director of the budget in Washington, D. C., has been named as the first city manager of Toledo, O. Mr. Edy was the unanimous choice of the new council which has had several informal meetings. His salary will be $12,000. He plans to begin his duties January 15. He has served as city manager in Berkeley, California; Flint, Michigan, and Dallas, Texas, and has been in public service ever since he was graduated as a civil engineer from the University of Missouri in 1909 with the exception of about 20 months, and is recognized as an expert on municipal finance and budgeting. Mr. Edy was state highway engineer of Montana when called to become city manager at Berkeley, California.

Charles M. Upham has been appointed as consulting engineer to the Maryland State Roads Commission. Mr. Upham will continue as engineer-director of the American Road Builders' Association. In connection with the appointment, it has been announced that Maryland is drafting a highway program to utilize most effectively all available federal and state funds for construction work.

Keith J. Evans has been appointed Manager of the Sales Promotion Division of Inland Steel Company, and will be in charge of advertising, sales statistics and commercial research. He has served in a similar capacity with Joseph T. Ryerson & Son, Inc., since 1917, and will continue to do so in addition to his new position with Inland Steel Company.

THE COAGULATOR FOR BETTER FLOCCULATION



Link-Belt COAGULATOR at Lakewood, N. J. Clyde Potts, Consulting Engineer.

Chemical precipitation in the treatment of sewage requires a thorough mixing of the coagulating chemicals with the sewage, followed by a gentle agitation of the entire mass, to form the large floccules that will settle out readily.

The Link-Belt mechanical COAGULATOR is a highly efficient, dependable, simple unit for this service. Its speed may be varied and the degree of agitation also varied without changing the speed. Send for further information.

LINK-BELT COMPANY

5561

PHILADELPHIA CHICAGO LOS ANGELES TORONTO Offices in Principal Cities

LINK-BELT

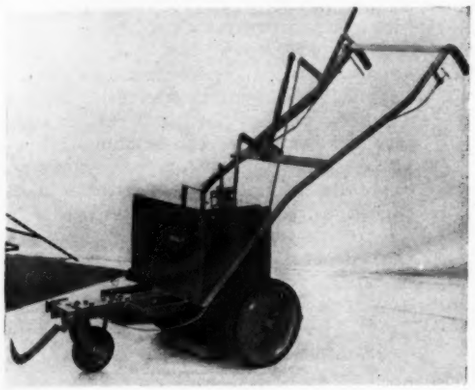
SCREENS • COLLECTORS • AERATORS • GRIT CHAMBERS • DISTRIBUTORS

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 51-53

A Look at Some New Equipment

Traffic Line Markers:

The South Bend marker, shown herewith, will mark lines on any hard surface, using any color paint, or hot or cold asphalt. The paint feeds by gravity; the surface is cleaned by a brush mechanism before the paint is applied; and straight edges are assured by self-adjusting side plates. The hand marker has a capacity of 3 quarts of paint; the wheel marker, shown, of 5 gallons. Full data from Municipal Supply Co., South Bend, Ind.



The South Bend Line Marker

Flame Traps

The Pacific Flush Tank Company has recently issued a 3-color bulletin, illustrating and describing their line of flame traps for eliminating the explosion hazard in sewage digesters.

Three types of flame traps "A," "B," and "B" Pressure Relief are described with flow charts and efficiency graphs on each, making this bulletin a very handy reference for engineers and others.

Waste gas burners, drip traps, indicating gauges and other Pacific Flush Tank Company sewage treatment equipments are also discussed in this folder which will be sent to all requesting it. Address the above company at 4241 Ravenswood Ave. Chicago Ill.

"Missing" Pipes Located

Making easier and more efficient the search for distant or deeply-laid pipes, thereby performing a real service for city engineers, gas companies and others, engineers of the General Electric Company have developed a new magnetic detector of extreme sensitivity and accuracy. The new detector has served satisfactorily in several emergencies so far, locating pipe lines laid more than 40 years ago. These were found as far as 100 feet from their supposed locations, and some of them were at seven-foot depths. The instrument indicated their presence within one diameter of the pipe.

Buckeye Spreader:

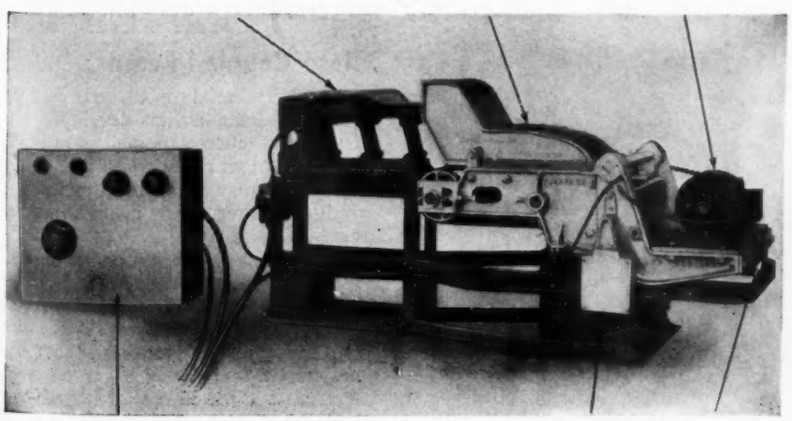
The new Buckeye surface material spreader is said to have two big advantages: First of these is the accuracy with which it distributes any material. The spirally fluted feed roll that controls the flow of material is so driven that the speed can vary over a wide range without disturbing the accuracy with which the material is distributed. Second is the neat way in which the machine lays down material to a definite edge. None is scattered around to be cleaned up after the spreading has been done. Nor is it ever necessary to follow the spreader with a crew to smooth up thick spots or fill in where material is too thin.

Constant Weight Feeder

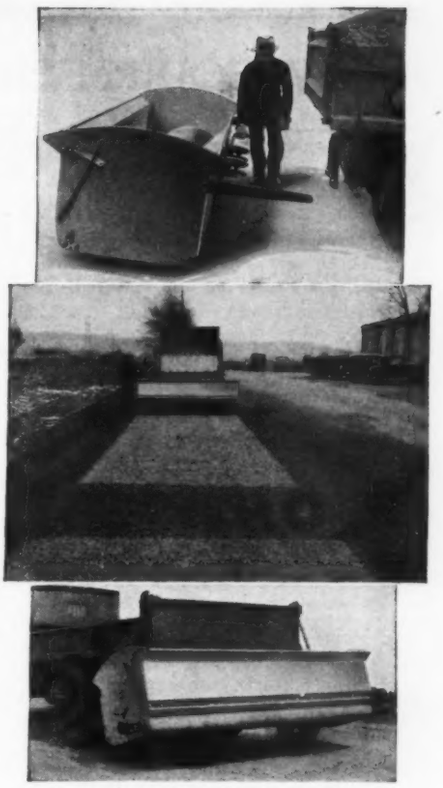
A new constant weight feeder for continuously feeding and weighing materials at accurate rates is announced by the Jeffrey-Traylor Division of the Jeffrey Manufacturing Co., Columbus, Ohio. It consists of a vibrating feeder controlled electrically by a balanced weighing belt equipped with an adjustable counterpoise for setting the desired rate of discharge. All gates for regulating the flow of material are eliminated and great weighing accuracy is obtained by virtue of the great sensitiveness of the scale. Through its electrical control, the vibrating feeder is regulated to satisfy the weighing belt at all times and thus keep it in perfect operating balance.

The cabinet control box may be located at the feeder or some distance away, using any number of remote control devices. On the control panel flasher lights at all times give visual evidence of correct operation. The unit operates from any a. c. light circuit.

This unit is accurate to plus or minus 1% or less, and can be set to deliver with uniform accuracy any rate from minimum to maximum. The capacity range of the unit here shown is 3 to 3,000 lbs. per hour. However, the principle and control system is adaptable to units of any capacity.



A New Constant-Weight Feeder by Jeffrey



Buckeye Material Spreader

Road Crossing Boring Machine:

This machine permits you to bore under railroads, streets, paved highways, etc., at a cost much less than trenching or hand tunneling, and in a much shorter time. It consists of a horizontal rotary drill which utilizes the pipe or casing to be installed. Rock or other hard formations do not prevent its use. Excellent for carrying water mains, sewers, or drainage structures or other utilities under embankments. Will handle pipe up to 36″ or 40″. We do not know the distance it will operate, but bores up to 300 feet long have been made. Available for outright sale or for rental. Write Young Engine Corp., Canton, O., for further details if you have such a problem.

NEW EQUIPMENT AND METHODS

Wright Cord Filter:

One of the notable exhibits at the recent Chemical Industries Exposition was a working demonstration of the new Wright cord filter in the booth of the Goslin-Birmingham Mfg. Co., Inc. The principle of filtration employed is novel for there is no filter cloth and its should have useful application for both municipal and industrial sewages.

The unit in the demonstration built up an excellent cake from beaten-up newspaper but samples of undigested sludge from the Shades Valley plant at Birmingham, Ala.; finely divided iron ore; raw cement slurry; and the white indoor pigment, lithopone, also produced uniform cakes. This would indicate that the machine can be applied to non-fibrous products as well as paper pulp suspensions.

In this new filter, all "woof" members have been abandoned and filtration is by means of an impregnated cord, which is endless.

Information on the new filter will be sent on application to the editor.

Dodge 1936 Trucks:

Featuring "fore point" load distribution, hydraulic brakes, "pre-proved" economy, beauty in appearance and Amola steel springs, Dodge division of Chrysler Corporation announces a new series of trucks and commercial cars for 1936. This new line will consist of the following chassis models: One-half, three-quarter, one, one and one half (in two series), two, three and four-ton models. Specially built custom Airflow models also will be offered.

Among the important innovations marking this new line of trucks is the "fore point" load distribution, through which the load is shifted forward in relation to the axles, giving greater stability, a minimum of over-all length, more nearly equalized wear on brakes and tires and, in general, a more efficient hauling unit.

One of the major changes in the construction of the new models is the adoption of a strictly truck-type of frame on the one-half ton commercial car.

Outstanding fuel and oil economy has been developed through six major mechanical features and advantages. They are: Aluminum alloy pistons, four piston rings, full length water jackets, valve seat inserts, spray cooled exhaust valve seats and special oil cooling.

Doors of all the 1936 trucks and commercial cars are hinged at the front.

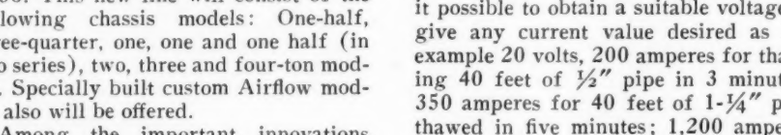
Amola steel, a recent metallurgical development of the Chrysler Corporation, which has high fatigue resisting qualities, is used in the springs of the entire 1936 line of trucks and furnishes an additional factor of safety.

A wide range of axle ratios, coupled with three, four and five speed transmissions, and several wheelbase lengths, permit these trucks to meet almost any transportation requirement.

Transformer Thaws Frozen Pipes:

Frozen water pipes varying from ½" inch iron to 2" copper pipe and in length varying from twenty feet to over two hundred feet have been successfully and conveniently thawed by the use of special transformers originally designed for use in making the connections of the windings of large water wheel generators and similar equipment. These make it possible to obtain a suitable voltage to give any current value desired as for example 20 volts, 200 amperes for thawing 40 feet of ½" pipe in 3 minutes; 350 amperes for 40 feet of 1-¼" pipe thawed in five minutes; 1,200 amperes to thaw 200 feet of 2" copper pipe in one hour.

It can readily be seen that this has a great advantage over the use of ordinary distribution transformers or welding equipment on which the maximum permissible current is limited by the full load capacity of the equipment. With this special transformer very high currents are available at very low voltage.



Showing the New Dodge Truck

New Small Tractor Grader For Rural Roads:

Declared to be the only one of its size in the field, the No. 22 tractor grader has been announced by Caterpillar Tractor Co. of Peoria, Ill. Hitherto, the only graders below the 5,000-pound class were horse drawn machines.

The new product has an 8-foot blade and weighs 3,575 pounds. It contains all of the design features offered in the four larger models. Advantages include welded box frame construction, adjustable tractor pole, leaning wheels and an extensible lift link for extreme blade positions. Its flexibility makes it equally adaptable for construction, ditching and maintenance work.

Built to match tractors between 20 and 35 horsepower, the No. 22 grader is expected to render a new service to road networks of townships and smaller cities.

International Two-Speed Axle Models:

International Harvester Company has announced the addition of three new models to its line of motor trucks, each of which features two-speed axle construction providing eight forward and two reverse speeds. With this construction all the advantages offered by both the high-speed and low-speed axle ratios are combined in one unit. The new models are the CS-30, CS-35, and CS-35-T.

The low-gear axle ratio enables heavy loads to be hauled up steep hills and over rough roads, while the high-gear axle ratio allows high speeds on level roads or with light roads. A simple movement of the shifting lever and the driver changes to either low-speed or high-speed operation instantly and silently without stopping the truck. This two-speed rear axle is available in both the 5.14 to 1-7.15 to 1 and the 6.16 to 1-8.57 to 1 axle ratios.

The Model CS-30 is available in two wheelbases—133 and 157 inches, while the Model CS-35 is offered in 136, 160 and 175-inch wheelbases. The six-wheeler Model CS-35-T is built in two wheelbases—168 and 180 inches. All have 6-cylinder motors.

Close Coupled Pumps:

The Westinghouse Electric & Manufacturing Company has developed a line of motors for close coupled pumps. This development was carried on in collaboration with a number of pump companies to produce a motor which would be standard for this application.

The pump is overhung on the motor frame and the pump impellor is pressed directly on the motor shaft. This construction eliminates bearings in the pump, couplings and bedplate. It also reduces the weight, and makes a far more compact unit, lower in cost, with the motor flexibly coupled to pump and both units mounted on a bedplate.

Readers' Service Department

CONTINUED FROM PAGE 52

These booklets are FREE to readers of PUBLIC WORKS.

Pipe Joints

410. New folder describes in detail a new type of pipe joint—the Dresser Compression Coupling, Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Pipe Joint Compound

411. A new bulletin has recently been issued giving full details concerning Tegul Mineralead, a quick-sealing, trouble-free compound for bell and spigot joints which permits immediate closing of the trenches. Write The Atlas Mineral Products Co. of Pa., Mertztown, Pa.

Taste and Odor Control

412. How, when and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Co., Inc., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Rubber Lined Tanks for Chemicals

414. Details of construction of Ace acid-proof, rubber lined, steel tanks for use in mixing and storing chemicals used in treating sewage and water are given in a new catalog issued by American Hard Rubber Co., 11 Mercer St., New York, N. Y. Covers all sizes up to 20,000 gals.

Rubber Lined Pipes and Pumps

415. New, 68-page catalog describes Ace rubber lined pipe and fittings, hard or soft rubber lined centrifugal pumps and Ace hard rubber double acting pumps, for chemicals used in treating sewage and water and for acids and other corrosive liquids. Contains illustrations and specifications. Issued by American Hard Rubber Co., 11 Mercer St., New York, N. Y.

Runoff & Stream-Flow

416. Technical information on measuring run-off, both from small areas, for storm sewer design, and from large areas for determining water-shed yield, and instruments for measuring. Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 307 No. Michigan Ave., Chicago, Ill. Book 642.

Rainfall Measurement

419. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

420. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sludge Bed Glass Covers

422. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Elizabeth, N. J. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Drying

424. Relatively dry cake sludge in demand for fertilizer is produced by automatic continuous vacuum filters like those used in Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C. Write for literature. Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

Sludge Incineration

427. A multiple hearth furnace which meets the most exacting municipal sanitary requirements for the incineration of sewage sludge—produces a fine ash or partially dry sludge for fertilizer—is described and illustrated with drawings and photographs in bulletins issued by Nichols Engineering and Research Corp., 40 Wall St., New York, N. Y. Operation as well as installation data is given.

428. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Sludge Removal Equipment

429. If you are interested in economical sludge removal, write for the latest bulletin describing and illustrating Louden Monorail equipment which is adapted to open or closed beds. Full details sent promptly by the Louden Machinery Co., 400 West Ave., Fairfield, Iowa.

Swimming Pool Equipment

430. Filters, chlorination, underwater lights and other supplies for swimming pools are very thoroughly described in literature and folders. Plans and layouts. Everson Filter Co., 625 W. Lake St., Chicago, Ill.

431. Data, and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Treatment

432. New 31-page catalog covers complete conveying, screening and reduction machinery for water purification and sewage treatment; describes and illustrates the design features of Jeffrey self-cleaning bar screen, combined screen and grinder, sewage screenings grinder, grit washer, conveyor type and positive discharge sludge collectors and green garbage grinder—includes installation views. Catalog 615, Jeffrey Manufacturing Co., Columbus, Ohio.

433. Installation views and considerable engineering data including capacity tables for settling tanks and layouts of typical arrangements for both final and primary tanks, are contained in a new booklet—No. 1542—just published for engineers by Link-Belt Company, 307 No. Michigan Ave., Chicago, Ill.

436. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

438. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

441. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link Belt-Co., 307 No. Michigan Ave., Chicago, Ill., and Philadelphia.

442. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 247 Park Ave., New York, N. Y.

Index to Advertisements

For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

Curing Concrete Roads:

This is a new booklet to be published by Solvay Sales Corp., 40 Rector Street, New York. It contains 32 pages of concise and precise information on use of calcium chloride, covering integral curing—moisture supply, temperature control, strength, workability, ease and economy of use, cold weather curing, and specifications. Also surface curing—methods, moisture supply, volume control changes, strength, surface durability and specifications. In addition, there are several pages of data on related subjects. Sent on request to above address.

A Pictorial Review of Modern Road Building:

This 60-page publication of the Jaeger Machine Co., Columbus, O., is certainly worth writing for. While it is, of course, devoted primarily to Jaeger equipment, the hundred or more excellent action pictures of highway construction are educational and interesting, and many of them show new kinks and new methods. A lot of information on curb, asphalt and other forms. One of the rare pieces of literature of interest alike to the engineer and the contractor. Copy on request.

Up-to-date Third Edition

Metcalf and Eddy's

American Sewerage Practice

VOL. III

Disposal of Sewage

892 pages, 6 x 9, 227 illustrations, 156 tables, $7.00

THIS volume deals with the problems and methods of treating sewage before it is released in natural waters. Covers fully the characteristics of sewage, the changes that may be made in it, the various processes of treatment, and the apparatus for applying these processes. See this new edition, fully revised, enlarged by 13 chapters.

Other books in the Series

Vol. I

Design of Sewers

759 pages, 6 x 9, fully illustrated, $7.00

Vol. II

Construction of Sewers

564 pages, 6 x 9, fully illustrated, $5.00

MAIL COUPON

PUBLIC WORKS, 310 E. 45th St., New York.
Enclosed is $7.00 for one copy of DISPOSAL OF SEWAGE, by Metcalf & Eddy. I reserve the privilege of returning this book in 10 days if not satisfied, in which case you will immediately refund my money.

Name .....

Street .....

City .....State .....

Testing Sieves:

Here is a 56-page booklet that tells you what you want to know about "The Profitable Uses of Testing Sieves." In stabilized road construction, in selecting soil for earth dams, in analyzing aggregates for all sort of concrete work, and in sand filter work, a knowledge of the use of sieves is necessary. Full of valuable data, charts, curves and specific directions. Write W. S. Tyler Co., Cleveland, O., and ask for Catalog 53, 1935 edition. No charge.

Sewage Plant Lubrication:

Here's what you want to know about lubricating your sewage treatment equipment: 12 pages of detail information covering all types (and most makes) of equipment—clarifiers, screens, conveyors, blowers, gears, housings, pumps and motive power. Write The Texas Co., 135 East 42nd St., N. Y. asking for December "Lubrication." No charge. Or PUBLIC WORKS will get it for you.

Concrete Curing:

Contains many charts and tables and much useful information regarding the use of calcium chloride in curing concrete structures, including pavements. We can recommend this as worthwhile. A copy on request to Columbia Alkali Corp., Barberton, O. No charge.

Stabilized Roads:

A booklet containing pretty complete information on stabilized roads. Contains charts of aggregate sizes, tables and much practical information on stabilization. Copy on request from Columbia Alkali Corp., Barberton, O.

Forms for Architectural Concrete:

The rapid growth of the use of concrete as an architectural material has prompted the publication of a 64-page booklet devoted exclusively to forms for architectural concrete work. The technique and craftsmanship of such form construction is quite different from that for structural concrete although fundamentally the same principles apply. Every conceivable detail has not been included in the booklet but sufficient examples are given and suggestions are made regarding those things requiring special attention to enable a thoroughly satisfactory job. The booklet also contains much information useful to architects in the preparation of specifications for architectural concrete work.

Copies may be had without charge from the Portland Cement Association, 33 West Grand Ave., Chicago.

Visiting London?

Hugh Miller, the editor of Highways and Bridges, London England, writes us that he is prepared to welcome visitors who wish to get in touch with highway engineering firms or other highway interests in England, and to assist with entirely disinterested advice. Mr. Miller's address is 256-257 Bank Chambers, 329 High Holborn, London W.C.1, and his telephone is Holborn 8630.

A Dirt-Movers Slide Rule:

That mathematical genius of the R. G. Le Tourneau Co. (Peoria, Ill), K. F. Park, has worked out a slide rule which shows how much dirt any of the Le Tourneau dirt-moving outfits will move per hour over any length haul, and the cost per yard. Write Mr. Park, c/o Le Tourneau, Peoria, Ill., for free rule.

Hard Rubber Protection:

A beautiful and thorough 64-page catalog of especial interest to those who have to combat corrosive solutions. In this brief notice we can call attention to only a few products: heavy-duty hard rubber pipe and fittings; rubber lined pipe and fittings; hard or soft rubber lined valves; hard rubber pumps, centrifugal, double acting and rotary; bottles; measures; tubes; rods, and sheets. American Hard Rubber Co., 11 Mercer St., New York. Sent on request; no charge.

Testing Petroleum Products:

A new 80-page Catalog 160 on "Apparatus for Testing Petroleum Products" has been published by the Precision Scientific Company, 1749 N. Springfield Ave., Chicago, Ill. Sent on request; no charge.

It contains detailed specifications and references to governing standards, notably the ASTM, and is compiled and arranged for quick, convenient reference, starting with "Asphalt" apparatus and proceeding by subject to "Viscosity." Of noteworthy importance is the ASTM reference index included, indicating at a glance the apparatus necessary for each ASTM Designation.

In addition to apparatus used specifically for testing petroleum products and bituminous materials, the catalog contains information on general utility apparatus, such as burners, electric heaters and hot plates, stirrers, constant temperature baths, etc. For laboratories running a large volume of identical tests, many multiple set-ups of apparatus are shown.

Industrial Lubrication:

Industrial lubrication reference manual contains information needed by modern industry for efficient lubrication maintenance of machinery. Lubricant recommendations for all types of industrial plants are given, classified according to types of machinery and according to types of gears and bearings. Illustrated with photographs and diagrams. All Alemite industrial lubricants fully described. A letter or postcard to Alemite, 1878 Diversey Parkway, Chicago, brings a free copy.